'Pictures of time beneath'

Science, landscape, heritage and the uses of the deep past in Australia

1830-2003

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This thesis contains no material which has previously been accepted for the award of any other degree or diploma in any university or other institution and, to the best of my knowledge, contains no material previously published or written by another person, except where due reference is made in the text of the thesis.

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Abstract

This thesis explores ideas about the deep past in Australia in the context of contemporary notions of geological heritage, cultural property, cultural identity and antiquity. Moving between disciplines, localities, stories and timescales it examines the complexities of changing intellectual agenda. But it does not pretend to present a complete history of the earth sciences in Australia. Rather it brings together an array of related themes, places, and stories, that knit into a narrative about the construction and interpretation of signs of age in Australian landscapes. Taking as its starting point the discovery by European settlers in 1830 of the Wellington Caves megafaunal fossils, which first suggested a long chronology for Australian vertebrate fauna, this work considers 'ordinary time' and 'deep time', geological heritage, the appropriation and celebration of deep time by settler Australians, and the naturalisation of narrative and sequence in geological writing.

The body of the thesis involves discussion of three landscapes which have been celebrated for the deep pasts revealed in their sediments, landforms and material remains: Hallett Cove and Lake Callabonna in South Australia and the Willandra Lakes in New South Wales. Each of these is regarded as more or less canonical in the respective histories of Australian geology, vertebrate palaeontology and archaeology, but each is also a living historical and geological site where people have lived, interacted with and interpreted the shape of the country for upwards of forty thousand years.
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Part One

The uses of the deep past in Australia

In making ourselves acquainted with the actual extent of our knowledge respecting the Geology, Mineralogy, Zoology, and Botany of South Australia, we are brought face to face with the fact that there are many missing pages, and even chapters, in its history¹

¹ R L Tate, 'Anniversary address by the president for 1877-8', Transactions and Proceedings and Report of the Philosophical Society of Adelaide, South Australia, 1878, 12.
Prelude

'Pictures of time beneath'

Landscape is always larger than itself. Different visions of canonical landscapes, placed within a broad historical framework, reveal a sense of time depth. This work explores ideas about the deep past in Australia since 1830, in the context of contemporary notions of geological heritage, cultural property, identity and antiquity. Moving between disciplines, localities, stories and timescales it examines the complexities of changing intellectual agenda. But it does not pretend to present a complete history of the earth sciences in Australia. Rather it brings together an array of related themes, places, and stories, that knit into a narrative about the construction and interpretation of Australian landscapes as landscapes in time.

For my purposes, a definition of landscape borrowed from the *Oxford English Dictionary* offers a beginning: a landscape is a 'tract or region of land with characteristic topographical features as shaped or modified by … processes'. Let us unpack the concept a little: a landscape is a patinated assemblage of the relics of past land surfaces, of the interactions, through time and space, of sub-surface geological and hydrological processes and above-surface climatic, biological, cultural, architectural and political influences. A landscape acquires meaning – aesthetic, economic and scientific – through being viewed. However, landscapes are more than the sum of their views, which are ephemeral, the product of a certain angle of the light, or of the realisation that sheep thrive on saltbush after all. Any given landscape is the accumulating demonstration of change over time, and can only be approximated in the present. 'Past' landscapes are only reconstructable through their traces left in present landscapes that are themselves built, as the American writer John McPhee put it, of 'chaotic, concatenated shards of time'.

Which is not to suggest that a landscape – in the sense of a place, at a particular time, of a particular extent – is not 'real' and tangible, but it may be overdetermined. A landscape is an expanse of countryside (in time) used as a vehicle for representations.

Until about 1830, the landscapes of British Australia did not have a deep

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past. Settlers regarded the flattened country with 'island-like' chains of low, rounded hills as confirmatory of the axiom suggested by its 'anomalous' biota and its 'primitive' indigenes, that the island-continent had emerged last from beneath the flood-waters that wiped away all but a boatload of humanity. In 1829 George Ranken, a Bathurst settler, found the bones of giant extinct marsupials in the limestone caverns of the Wellington Valley in central New South Wales, proving that Australia's marsupial fauna, at least, had a pedigree comparable with the mammals of Europe and the Americas.

From then its past deepened inexorably, until the last of lands became the oldest continent, its flora and fauna adaptive instead of relict and its indigenous people ancient rather than primitive, culturally varied rather than homogeneous through space and time, providing a sterling example of cultural continuity and adaptation since the Pleistocene. By the time Ralph Tate arrived in South Australia from London in 1875, as the inaugural Professor of interesting things at the University of Adelaide, a consciously independent indigenous science had gained a toehold in the fledgling cultural institutions and societies of the Australian colonies. Tate's presidential address in 1878 to the rejuvenated Philosophical Society of Adelaide (soon to become the Royal Society of South Australia), quoted in part at the beginning of Part One, stressed the need for local knowledge and the refinement of Australian science to reflect the southern continent's geological and biological singularity. Models borrowed from the Old World and applied to the Australian situation reflected 'mere technical barrenness'. In comparison, the new indigenous science, refracted through the aims of the society and the vision of its president, was to be 'real, practical, and interesting'.

During the last two hundred years the stratigraphic sciences – geology, palaeontology, archaeology – have changed the way people see the world, particularly as regards the recognition and interpretation of signs of age in the earth. Their differentiation and professionalisation in the nineteenth century paralleled the 'backward' extension of earth history in the Western scientific canon. Curios in their own right, Australian natural history objects and indigenous material culture were in particular demand among European and British scientists for the

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3 Tate was appointed to the 'Elder Chair of Natural Sciences, including Geology, Mineralogy, Palaeontology, Zoology and Botany'.

 PART ONE – THE USES OF THE DEEP PAST IN AUSTRALIA
correspondent glimpses they were understood to offer into the deep past of the Old World. Living Australian fauna appeared to provide proxies for European fossils of the early Tertiary period (regarded today as spanning roughly sixty five million to two million years ago). Mainland Australian and Tasmanian Aboriginal people were equated respectively with the fossil Cro-Magnon and even more 'primitive' Mousterian cultures of Europe. Australian rock sequences provided important global correlations and could be 'fitted in' to European systems.

As colonial cultural institutions and government surveys became established, many of their directors and collectors, while still willing to send casts and duplicates of specimens to the British institutions that may have spawned them, were eager to exploit the material remains of the Australian past in the interest of developing local science and training local scientists. Australian and New World natural history eventually provided a corrective to a predominantly Eurocentric view of creation. For example Othniel Charles Marsh, North America's leading vertebrate palaeontologist in the mid-nineteenth century, recognised the American ancestry of those poster-children for European civilisation, horses. The prominent British naturalist and Darwinian evolutionist, Thomas Henry Huxley, proposed a linked equine evolutionary sequence of three European fossils in 1870. Marsh convinced him six years later that the far richer American record proved instead that the European fossils represented three separate incursions of American stock into Eurasia. Extinction in Europe followed each radiation.4

In Australia, the discovery of fossil plants and animals in the continent's interior proved the pedigree of Australian flora and fauna. By the early 1860s, the priest and natural historian Julian Tenison Woods wrote confidently of the age and uniqueness of Australian landscapes.5 At the University of Adelaide, the geologists Walter Howchin and Douglas Mawson discovered Pre-Cambrian glacial surfaces and sediments, initially in the Mt Lofty Ranges and later inland in South Australia in the 1890s and 1900s, known in Australia as the Sturtian Glaciation. These discoveries helped to set the stage for one of the most exciting and contentious


geological hypotheses of the last two decades. Adherents to the 'snowball earth' theory suggest that between about 750-600 million years ago, the earth's climate oscillated between such severe 'greenhouse' and 'icehouse' conditions that at times the entire surface of the planet might have been covered in ice. These periods were interspersed with runaway greenhouse conditions. Such extreme environments during the Neoproterozoic era perhaps triggered the evolution and radiation of multi-celled animals and later the development of hard parts like exoskeletons and vertebrae.

Physical anthropologists and earth scientists contested human antiquity in Australia for nearly two centuries, until John Mulvaney's work at Fromm's Landing on the Murray River and at Kenniff Cave in southern Queensland during the 1950s and 60s and the discovery of human remains at Lake Mungo in the 1960s and 70s established an age of at least 25,000 years for Aboriginal inhabitation. Lake Mungo also contains evidence for the earliest use of ochre and of cremation in funerary rites yet discovered in the world.

Several historians have tracked these changes during the nineteenth and twentieth centuries, when (to render a complex commerce very simplistically) Australian natural sciences shifted from 'imported' knowledge, heavily reliant on Europe and Britain for a supply of practitioners and theory, to 'indigenous' sciences of which Ralph Tate would have been proud. The same period saw a

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8 John Mulvaney and Johan Kamminga, Prehistory of Australia (Sydney: Allen & Unwin, 1999).

9 Among others, see Tom Griffiths, Hunters and Collectors: The Antiquarian Imagination in Australia (Melbourne: Cambridge University Press, 1996); idem, 'Deep time and Australian history', History Today 51(11), 2001, 20-8; Sally Gregory Kohlstedt, 'Australian museums of natural history: Public priorities and scientific initiatives in the nineteenth century', Historical Records of Australian Science 5(4), 1983, 1-29; Roy MacLeod, 'On visiting the "moving metropolis": Reflections on the
transformation from the interpretation of Australia as a geologically young continent to recognition of the great age of some of its landscapes, landforms, cultures and biota.

This thesis addresses the ways in which Australian settlers after 1788 and visitors to Australia have conceived, mobilised and popularised notions of deep time since 1830, in the process memorialising particular sites, landforms, stories and objects. It focuses on three sites, or sets of landscapes, each considered by earth scientists as somehow emblematic of the development of their disciplines in Australia: Parts Two and Three, respectively the Hallett Cove Conservation Park and the Lake Callabonna Fossil Reserve, are located in South Australia, and Part Four, the Willandra Lakes World Heritage area, is in south-western New South Wales (Plate 1).

These case studies are three among many, distinguished from other possible studies and from each other by the particular stories they tell about the way landscapes are envisioned. Resonances build across the studies, which produces some considered repetition, and some apparent irregularities in length between Parts Two, Three and Four. Each is necessarily a different type of essay, reflecting the nature of the stories of the landscapes, and the received truths, but also of the archives and the published materials available.

The Hallett Cove Conservation Park is about twenty kilometres south of Adelaide. It was preserved from encircling suburbia in 1975, primarily because of the 280 million year old Permian glacial features discovered there one hundred years earlier, and their contribution to geological debates spanning the same century, from the possibility of Australian glaciation at sea level, first postulated in the 1870s, to the plate tectonic revolution of the mid-twentieth century.

The second case study involves the Lake Callabonna Fossil Reserve south east of Lake Eyre in South Australia, specifically the graveyard of giant extinct marsupial fossils first delivered to western science in 1892, but also considers the arid landscapes of the Lake Eyre basin and the people who have shaped meaning in 'Architecture of imperial science', in Scientific Colonialism, a Cross-Cultural Comparison, eds, N Reingold and M Rothenberg (Washington DC: Smithsonian Institution Press, 1987), 217-51; Ann Moyal, 'A Bright & Savage Land': Scientists in Colonial Australia (Sydney: Collins, 1986); N Reingold and M Rothenberg, eds, Scientific Colonialism, a Cross-Cultural Comparison (Washington DC: Smithsonian Institution Press, 1987).
The third episode begins with the discovery of a collection of split and charred bones protruding from a blowout on a sand dune by a dry lake in western New South Wales, identified as the Pleistocene human cremation which is now known as Lake Mungo 1 or Mungo Lady. Following this moment of discovery and its unravelling, which have taken on mythic overtones in the 35 years since Mungo 1's discovery, Lake Mungo and the other dry lakes in the Willandra chain were inscribed on the World Heritage List in 1981 for their cultural, archaeological and geomorphological significance.

Landscape, the geosciences and heritage are linked historically, imaginatively and practically in the study of changing ideas about Australia's deep past. Geoscientists explain particular features as signs of age. Their interpretation allows the partial reconstruction of the shape and nature of past land surfaces, climates and ecologies. Age in the landscape is used for national and parochial ends, to trace continuity and discontinuity, to claim, test, contest or erase ownership, community and custodianship. Antiquity provides a surrogate for topographic grandeur or productivity. Landscapes regarded as wastelands are given legitimacy as sites of natural heritage by virtue of the signs of longevity they demonstrate, particularly when this involves the human past. The celebration and World Heritage classification of indigenous 'cultural landscapes' such as Uluru and Kakadu is part of this incorporation of human antiquity and continuity in Australia into the post-1901 nation.
Chapter I

Geology and the politics of time and place

*Stories about landscape*

The next three chapters constitute an extended introduction to the thesis. Each examines concepts of relevance to all three case studies. Chapter One encompasses geological models and metaphor. An exploration of the narrative aspects underpinning geological representation leads to discussion of the inevitable naturalisation of 'time' and 'deep time' in the earth sciences. All landscapes are clearly landscapes in space. They are not so clearly landscapes in time. An awareness of the four-dimensional geometry of country is a fundamental element of a geologist's cognitive tool kit. Chapter One closes with a reflection on the recursive nature of much scientific knowledge and a short discussion of each of the case studies.

Chapter Two addresses landscapes as historical artefacts – not so much in the sense that they are taken to signify a certain historical moment or event, but as vessels for representation more generally. While landscapes can be understood to embody particular stories, they are also hooks on which to hang identity. Landscapes and their material productions in the fourth dimension, celebrated for the signs of antiquity encoded therein, allow nations like Australia to transcend the simple short chronology of settlement and Federation. A discussion of the 'archaeological' nature of geological writing and a brief survey of the literature relating to the case studies precede a meditation on landscape, deep time and national identity.

Chapter Three looks at how these landscapes in deep time can be managed, who has stakes in them and why and how they are valued. It finishes with a short study of the Naracoorte Caves, suggesting that 'actual' country and 'stories about' country are built out of each other. This demonstrates in outline my approach to the larger studies of Hallett Cove, Lake Callabonna and the Willandra Lakes. Any landscape is a metaphysical tangle of geological, intellectual, biological, climatic, cultural and political elements.
Narrating the deep past

Geology, serendipity and determinism

Archaeology, palaeontology and the geological disciplines (including among others glaciology, palaeoclimatology, geomorphology and geology) depend very literally on the contingencies of data collection – the serendipitous processes of preservation (taphonomy) and discovery of fossils, features and artefacts – to construct scientific knowledge. The Australian palaeontologist W D L (David) Ride wrote in 1985 of the discipline in Australia that 'serendipity played its part from the very beginning … adventurous, inquisitive, and acquisitive people found things that were interesting and important'.

Witness, for example, the then Berkeley graduate palaeontologist Dick Tedford's mingled delight and frustration, four days into fieldwork at the Lake Callabonna fossil site in South Australia, in June 1953: 'Five weeks in the field today – our 4th day on vertebrate fossils!'.

Separated from Tedford by a century and a Darwinian paradigm but similarly stressing the fortuitous nature of palaeontological discovery, the Scottish geologist Hugh Miller explained his apparent philosophical 'inconsistency', in shifting from a literal Mosaic understanding of Creation to 'that scheme of reconciliation between the Geologic and Mosaic Records which accepts the six days of creation as vastly extended periods', in both teleological and mechanistic terms, as a consequence of the unreliability of the fossil record:

I certainly did once believe with Chalmers and with Buckland that the six days were simply natural days of twenty-four hours each, … and that the latest of the geologic ages was separated by a great chaotic gap from our own. My labours at the time as a practical geologist had been very much restricted to the Palaeozoic and Secondary rocks … During the last nine years, however, I have spent a few weeks every autumn in exploring

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the later formations, and acquainting myself with their peculiar organisms … And the conclusion at which I have been compelled to arrive is … That day during which God … at length terminated His work by moulding a creature in His own image … was not a brief period of a few hours' duration, but extended over mayhap millenniums of centuries. No blank chaotic gap of death and darkness separated the creation to which man belongs from that of the old extinct elephant … and so I have been compelled to hold, that the days of creation were not natural, but prophetic days, and stretched far back into the bygone eternity … I have yielded to evidence which I found it impossible to resist; and such in this matter has been my inconsistency, – an inconsistency of which the world has furnished examples in all the sciences, and will, I trust, in its onward progress, continue to furnish many more.3

I am uncomfortable with a teleological approach to the understanding of the generation of geological ideas. It seems to me that, in the earth sciences at least, this dependence on the fortuitous unearthing of 'new' data – contingency – controls the unfolding of geological theories. Nonetheless, they are historical sciences, grounded in the reconstruction of present and past landscapes, past events, past relationships and past ecologies. This historical aspect, central to the presentation of geological ideas, makes it difficult to resist a narrative, if not deterministic, approach both to geological accounts of the earth and to understanding the 'development' of the earth sciences.

For most earth scientists, narrative is an unconscious representational strategy and an occupational hazard. They describe sequential relationships between – or tell stories about – the material remains of the deep past. Borrowing from Hayden White, geology is thus both a 'discourse that narrates and a discourse that narrativises' in the sense that its practitioners adopt a self-consciously objective position 'that looks out on the world and reports it' while simultaneously they

3 Hugh Miller, The Testimony of the Rocks: Or Geology in its bearings on the two Theologies, Natural and Revealed (Edinburgh: Shepherd and Elliot, 1857), x-xi.
attempt 'to make the world speak itself and speak itself as a story'.

In contrast Henry Gee, a zoologist by training and senior editor at *Nature*, argued in the lively and iconoclastic *Deep Time: Cladistics, the Revolution in Evolution* (2000) that a cladistic approach to the fossil record – that is to say, one which rejects the search for origins, lineages and genealogical relationships between living and fossil organisms, seeking instead to approximate degrees of relatedness – is the only feasible method of mapping evolutionary relationships. He insisted that 'the scale of geological time that scientists deal with' is 'so vast that it defies narrative'. Time is a 'fathomless sea' in which 'each fossil is an infinitesimal dot', whose genetic relationships are indiscernible.

Gee argued that the fossil record is not a record as such, but shafts of light illuminating disconnected 'tableaux of unfamiliar characters' in doorways off an infinite darkened hallway 'with no landmarks to give it scale', representing deep time. The contents of the spaces between the shafts of light are largely unknowable, a useful analogy for the relationships between all species, living and fossil: 'Any story we tell against the compass of geological time which links these fossils in sequences of cause and effect – or ancestry and descent – is, therefore, only ours to make. We invent these stories, after the fact, to justify the history of life according to our own prejudices'. All organisms are 'cousins' in deep time, but – such is the serendipitous, incomplete (and incompletable) nature of taphonomy and field work – our exact relationships remain unopenable doors in the darkened hallway.

Despite Gee and the cladists, the search for links and causes continues. Perhaps, far from 'defying' narrative, the desire of scientists to see the connections between things encourages it. Even Henry Gee resorted to a pictorial analogy, and one which implies sequence, in the idea of scenes or tableaux off 'an endless, dark corridor' (his image of dots 'lost in a fathomless sea' served him better). The search

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5 It is notable that while 'Deep Time' according to Gee's understanding may defy narrative, at no point in the book does the author see fit to define 'narrative', beyond alluding to chains of cause and effect.


7 Gee, *Deep Time*, 1-2.
for causes, connections or origins might appear unscientific, but the advantage of geological synthesis is just that: it attempts a syncretic explanation for changes in the earth over time which is holistic as well as geographically specific, generalising from the local to the regional to the global; and, like all sciences, it operates within an evidential paradigm. It makes claims about 'reality', but ideally its own methods undermine these eventually. As George Seddon, declaring that there 'is no such thing as THE scientific method', put it, the fact that a geological scenario is speculative and not immediately subject to falsification does not necessarily render it useless or 'unscientific'. It may well have testable consequences, which emerge in time. So he classed geologists as 'impure Popperians'.

Deep time in pictures

'Pictures of time beneath', the title of this work, is how the South Australian writer Nicholas Jose in The Custodians, his meditation on national identity and the meaning of the past, irresistibly evoked the skill of the 'X-ray eyed' earth scientist who sees 'through the surface of the land' to recover past worlds and lost time. Jose's use of such an analogy to describe the intellectual reconstitution of past environments and land surfaces is part of a long tradition of pictorial or 'scenic' representation of the geological past. The past has both depth – 'beneath' – and breadth – as implied by his conceit of 'pictures'.

Martin Rudwick, a palaeontologist and influential historian of science, has written widely on the earth sciences as practised in eighteenth and nineteenth-century western Europe. In Scenes from Deep Time, published in 1992, he discussed pictorial representations of the deep past in nineteenth-century contexts. Rudwick began with examples of biblical panoramas showing the seven days of Creation, moving on to discuss Henry De la Beche's panoramas of ancient Dorset and Benjamin Waterhouse Hawkins' 'life-sized', model dinosaurs built for the Great Exhibition of 1851, among other examples, culminating with Louis Figuier's La Terre avant le Deluge. Rudwick pointed out in an introductory statement that the 'realistic style' of these 'temporal panoramas' invites viewers 'to imagine that we are

8 G Seddon, 'Thinking like a geologist', 491, 490, 494.
seeing the deep past with our own eyes, unproblematically, as from a time machine.\textsuperscript{11} We can extend his example to argue that the popularity of modern museum exhibitions (and by extension, films like 'Jurassic Park') rests partly on the fact that the dinosaur-viewing public has long been educated to a cinematic appreciation of the deep past.\textsuperscript{12} The propensity of nineteenth-century artists to crowd their 'scenes' with roughly contemporaneous life-forms is replicated by programs like the BBC's 'Walking with Dinosaurs' and 'Walking with Beasts'. In De la Beche's famous Dorset panorama, giant mosasours prey on dolphin-like icthyosaurs, in turn hunting extinct cephalopods, the ammonites and belemnites. Plesiosaurs haunt the shallows, resembling swan-like submarines or the Loch Ness monster. Above, pterodactyls surf the air, wary of the aquatic carnivores below.\textsuperscript{13}

For the last two centuries, earth scientists and museums have often exploited the narrative potential of dioramas, presenting a series of linked scenes in either two or three dimensions, abbreviating the innumerable variety of life to an inevitable, reasonably linear progression from uni-celled organisms to the pinnacle of Darwinian evolution, modern humankind. A number of twentieth-century anthropologists, earth scientists, historians of science and cultural commentators has pointed out the inconsistency of a Eurocentric, progressive and ultimately anthropocentric view of evolution, history and the past.\textsuperscript{14} Of this tendency to emphasise apparently increasing diversity and complexity as a sign of 'progress', the Australian geologist Ian Plimer complained in 1997 that, owing to their longevity and adaptability, 'bacteria are at the pinnacle of life on Earth, and it needs to be said that we humans have an ego incommensurate with our evolutionary place in Nature'.\textsuperscript{15}

\textsuperscript{11} Rudwick, \textit{Scenes from Deep Time}, vii.

\textsuperscript{12} Rudwick, \textit{Scenes from Deep Time}, 229, 253.

\textsuperscript{13} Reproduced in Rudwick, \textit{Scenes from Deep Time}, 45. See page viii for his comment on 'crowding' a variety of organisms 'that would be unlikely to pose so obligingly together in real life'.


\textsuperscript{15} Plimer, \textit{A Journey Through Stone}, 102-3.
Pulling the pieces together

In contraindication to Henry Gee, George Seddon, delivering the 1996 Mawson Lecture on the topic of the 'culture of geology', pointed out that much geoscientific research 'is relational', seeking 'a comprehensive explanation that shows the linkages between superficially unrelated data'. While not peculiar to the earth sciences, this search 'is characteristic' of them. The relational aspect, in the sense that geological data often represents sequential events, has a 'narrative component', but even if 'sequence is of minor importance, the comprehensive explanation constitutes a "story"'. Seddon called this diagnostic or narrative aspect 'pulling the pieces together'. Unlike Gee's 'anti-historical' approach to palaeontology, which demands the rejection of narrative, for Seddon, narrative is part of the conceptual make-up of geologists and is a useful heuristic tool. Add scenic representation to Seddon's 'relational' or narrative approach and we have a visual story, or diorama, our 'scenes from deep time' knitted together into a film or slideshow.

The literary theorist Stephen Greenblatt argued, of mediaeval travelling storytellers, that representation and reality 'are locked together in an uneasy marriage'. It is a 'theoretical mistake and a practical blunder to collapse the distinction between' them, but unfortunately, 'we cannot keep them isolated from one another'. The naturalisation of visual metaphors in the earth sciences distances geoscientists from the ambiguity and instability of their observations, a tendency which Gee decries and which cladists purportedly seek to undermine. Models become 'real'.

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16 The Mawson Lecture is an annual lecture established in 1987 by the Australian Academy of Science 'to mark the outstanding contribution to science in Australia by [the late South Australian geologist and Antarctic scientist] Sir Douglas Mawson ... It is given by the earth scientist (normally resident in Australia) who may appear to the Council of the Academy to be most deserving of such an honour'. Seddon's lecture, the tenth Mawson Lecture, was delivered on 23 February 1996 at the 13th Australian Geological Convention in Canberra. It appeared later that year in the *Australian Journal of Earth Sciences* (Seddon, 'Thinking like a geologist', 487).

17 Seddon, 'Thinking like a geologist', 488.

18 Gee, *Deep Time*, 7-10. In part this comes down to a difference of definition. Although Gee never defines precisely what he means by 'narrative', it seems he has conflated it with teleology. For Seddon, 'narrative' stands for the attempt by earth scientists to demonstrate the relations or 'linkages' between pieces of geological data. This is not to suggest that he would reject any less vigorously than Gee the recourse to teleology or the apparent inevitability of hindsight – the conflation of sequence and posteriority with cause and design.

Perhaps as a consequence of the cinematic, narrative or dioramic mindset, earth scientists are prone, consciously or unconsciously, to represent geological data as 'bits of the jigsaw', as a 'rock diary', as 'many different windows in time' or as 'stories written for us in stone'. Even the term 'geological record' evokes a sense of narrative. So eminent a commentator as Charles Darwin described such a geological record as 'a history of the world imperfectly kept, and written in a changing dialect' of which 'we possess the last volume alone' and of that, but 'here and there a short chapter' with only 'a few lines' preserved on each page. Ralph Tate, an outspoken Darwinist, might well have borrowed the image that announces this introductory essay, of 'missing pages, and even chapters', in a history of South Australia, from Darwin's most influential monograph. In book two of *Annals of the Former World*, called *In Suspect Terrain*, John McPhee quoted Anita Harris, a United States Geological Survey geologist, describing the geological record similarly with a literary metaphor. 'Rocks remember', she said. They are 'the record of events that took place at the time they formed'. They are 'books' with 'a different vocabulary, a different alphabet', but they can be read. At one point Harris wanted to major in history: 'My teachers steered me into science, but I really majored in history … I remember how amazed I was to discover, in learning how to read rocks, how much history there was'.

The calculated rhetoric of Darwin's, Tate's and even Harris' self-consciously overstated literary metaphor can be traced back to the compelling imagery of Francis Bacon's seventeenth-century behest that men be equally 'studied in the book of God's word' – Scripture – 'or the book of God's works' – Nature. This is

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22 R L Tate, 'Anniversary address by the president for 1877-8', *Transactions and Proceedings and Report of the Philosophical Society of Adelaide, South Australia*, 1878, 12.


the literary version of Gee's 'dark corridor', not a rejection or refutation of narrative, but a wholehearted embracing of it. It is difficult to resist the teleology inherent in the idea of a 'volume', a 'jigsaw', an 'ever-widening window', an 'accurate picture' or set of 'windows in time' hinting at the existence of a whole, a complete picture or narrative or history, the 'relics', 'pieces' or 'clues' of which have been 'left for us' to 'piece together'. Such visual and narrative representation has an heuristic value for scientists and educators. It is a means to grasp the inconceivable.

**On time**

**Time and space**

While on the theme of naturalising models, no discussion of the deep past can ignore the inextricability of time-space metaphors. Discussing the 'secularization of Time', which preceded the articulation of social evolutionary theory in the late eighteenth and nineteenth centuries, the anthropologist Johannes Fabian observed in 1983 two self-evident temporal 'truths in the industrializing and colonizing West': namely that

1) Time is immanent to, hence coextensive with, the world (or nature, or the universe, depending on the argument); 2) relationships between parts of the world (in the widest sense of both natural and sociocultural entities) can be understood as temporal relations.

So to summarise, 'Dispersal in space reflects directly, which is not to say simply or in obvious ways, sequence in Time'.

Herbert Spencer 'visualized evolution, not as a chain of being, but as a tree'
describing 'a taxonomic approach to socio-cultural reality'. Ever since, Fabian argued, 'anthropology's efforts to construct relations with its Other by means of temporal devices implied affirmation of difference as distance'. Early nineteenth-century geological temporalising reflected these axioms as well, for instance, in the convictions of many British and European naturalists that living Australian biota represented 'primitive' European forms. To travel to Australia was to travel backward in time, culturally and biologically. Continuing the spatial metaphor, the science of stratigraphy and the laws of superposition demanded a literal correlation of depth with age. Depth of strata 'reflects directly, which is not to say simply or in obvious ways, sequence in Time'.

John McPhee is often credited with coining the phrase 'deep time', although archaeologists, palaeontologists and geologists have long used notions of time depth as a convenient shorthand. But the term at least took popular shape in the perceptive, sometimes brilliant Basin and Range (1981), McPhee's metaphysical and literal road trip along the Interstate 80, through a history of North American geological ideas and landscape evolution. McPhee used the phrase partly to recapitulate the boundlessness of its astronomical counterpoint, the 'deep space' of Carl Sagan – which is measured in years. It equally powerfully evokes the boundedness of a stratigraphic layer or an archaeological trench. To dig is to make an intellectual journey in time – which is measured in metres.

Fabian, writing of the practical advantages of a long chronology to social evolutionary theorists, similarly highlighted the inextricability of space from

29 Fabian, Time and the Other, 15-16.
32 McPhee likened James Hutton's recognition at the end of the eighteenth century of the unfathomably long chronology of earth history 'which, in years to come, would gradually remove the human world from a specious position in time' to Copernicus' intellectual leap in astronomy which 'removed us from a specious position in the universe' (McPhee, Annals of the Former World, 74). The British comparative anatomist Richard Owen made a similar metaphorical leap from time to space in 1860, when he wrote that palaeontology teaches 'that the globe allotted to man has revolved in its orbit through a period of time so vast, that the mind, in endeavouring to realize it, is strained by an effort like that by which it strives to conceive the space dividing the solar system from the most distant nebulae' (Richard Owen, Palaeontology [Edinburgh: Adam and Charles Black, 1860], 2).
geological time with an allusion to astronomy: the discipline geology, he declared, 'construes Time from spatial relation and distribution' more than 'any other, astronomy excepted'.\(^{33}\) Fabian continued that anthropology's temporal discourse 'as it was formed decisively under the paradigm of evolutionism rested on a conception of Time that was not only secularized and naturalized but also thoroughly spatialized'.\(^{34}\) The same could be said of the geological sciences.

'Ordinary time' and 'Deep Time'

Words like 'unfathomable', 'abyssal', 'vast', and 'unimaginable' roll easily off the fingertips when trying to describe the age of the universe, or the earth, or even the Quaternary Period (the name given to the last approximately two million years of geological time) according to modern scientific orthodoxy.\(^{35}\) Seddon called it a "'Gee whiz" element in the perception of geological time'. 'Numbers do not seem to work well with regard to deep time', wrote McPhee: 'Any number above a couple of thousand years – fifty thousand, fifty million – will with nearly equal effect awe the imagination to the point of paralysis'. In this respect Gee agreed with McPhee, and in his rejection of geological narrative insisted on a dichotomy between lived time – "'everyday time" or "ordinary time"" as he called 'the richly interwoven tapestry of time afforded by our everyday experience' – and 'Deep Time' which is 'something far beyond everyday human experience'. But deep time could be seen as nothing other than an unimaginably great number of parcels of 'ordinary time' stacked together. Is the difference merely quantitative?\(^{36}\)

Lived time, according to Gee's understanding, seems to be the sum of human memory and recorded history, subtracted from human experience. This 'ordinary time' is nuanced and divisible and 'time', 'change', 'history' and 'memory' are elided in his delineation of lived experience. 'Deep Time' on the other hand is reified and amorphous. The qualitative difference Gee remarked upon stems from the 'unknowableness' of 'Deep Time', which is not made up of 'everyday

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\(^{33}\) Fabian, *Time and the Other*, 168, note 15.

\(^{34}\) Fabian, *Time and the Other*, 15-16.

\(^{35}\) The Quaternary Period is further divided unevenly into Pleistocene and Holocene (or Recent) epochs. The Pleistocene ended roughly ten thousand years ago, succeeded by the Holocene which is ongoing (see Plate 2).

experience', but of 'Time' itself. Simply stated, there are fewer markers of 'experience' or 'event' in Gee's 'Deep Time' on which to hang a 'narrative'. Furthermore, his book does not address degrees of time depth. What about the difference between ten thousand years of 'Deep Time' and one hundred million? Four orders of magnitude are elided into the 'endless, dark corridor'.

In contrast to Gee and McPhee, Seddon found that familiarity breeds, not exactly complacency, but a certain 'matter of fact'-ness in geologists. While they 'deal every day in figures which to non-geologists may still be breathtaking', there 'can be no doubt that a constant awareness of the scale of geological time moulds the consciousness of every geologist', making it 'difficult to see our own species as an end-point, as if creation had now reached its goal and therefore come to a halt'. Notwithstanding the search for discernible patterns, an 'awareness of change as natural and continuous makes the search for constant systems seem doomed to failure'. A knowledge of earth history and of the relative vastness of geological time compared to lived human experience 'is likely to induce a degree of scepticism about relatively simple explanations of complex phenomena', which is not to say that complex hypotheses are not regularly reduced to relatively simple models in the forums of popular science, in the interests of communication and comprehensibility.37

However, rather than eschew explanations or syntheses, Seddon suggested that experience validates the creation of geological 'scenarios' such as Gee derided in the sister discipline of palaeontology. As a cautionary tale illustrating the utility of supposedly unfalsifiable, 'non-scientific', largely speculative hypotheses, Seddon and McPhee each offered Alfred Wegener's initial thesis of continental drift of 1915.38 Wegener was wrong, according to both contemporaneous and later geodynamic accounts of the ancient configuration of the continents, and he proposed no mechanism for moving gigantic, fixed landmasses around the ocean, other than the image of continents 'plowing like icebreakers through solid basalt'.39

37 Seddon, 'Thinking like a geologist', 490-1.


But his early idea provided fertile ground for the seeds of the concept of ocean-floor spreading and plate tectonics, arguably the most powerful geological synthesis of the twentieth century. McPhee quoted Kenneth Deffeyes, a lecturer in geology at Princeton, on the tendency of earth scientists to assemble apparently unconnected phenomena into a single, synthesising hypothesis, as with plate tectonic theory: 'All science involves speculation and few sciences include as much speculation as geology'. Knowledge of the deep past may be fleeting and disconnected, but we have a lot of time to work with, and 'numerous, disparate phenomena' from the long dark corridor to spin into a narrative.

Fabian, still writing about anthropology but equally applicable to the geological writings of Gee, McPhee and Seddon, suggested that the 'idea of a knowledge of Time which is a superior knowledge' is an integral part of the intellectual equipment of the discipline. A related opposition can be drawn between modern secular geological paradigms and other or older ways of understanding and describing change in the landscape. This particularly seems to be the case with geologists as described by McPhee. He wondered whether 'the human mind' has 'evolved enough to be able to comprehend deep time. It may only be able to measure it'. Essentialising shamelessly and assuming a post-Enlightenment, secular, western audience, he continued with the assertion that 'People think in five generations – two ahead, two behind – with heavy concentration on the one in the middle'. 'Geologists' are exceptional in this respect. Trapped between the constantly shifting timescales of lived human experience and of geological time, 'they'

wonder to what extent it is possible to absorb a set of facts and move with them, in a sensory manner, beyond the recording intellect and into the abyssal eons … They see the thin band in which are the all but indiscernible stratifications of Cro-Magnon, Moses, Leonardo, and now. Seeing a race unaware of its own instantaneousness in time, they can reel off all the species that have come and gone, with emphasis on those that have

42 Fabian, *Time and the Other*, 10.
specialized themselves to death. In geologists' own lives, the least effect of time is that they think in two languages, function on two different scales.43

'Cro-Magnon, Moses, Leonardo, and now' are 'all but indiscernible stratifications'. Roadcuts are 'windows into the world as it was in other times'.44 More than a sharp division between strata, a stratigraphic boundary denotes a 'disassembled world', forty million years of earth history.45 According to McPhee's characterisation, strata more than represent the passage of geological time, the mere remnants of former geographies. They are the essence of deep time itself.

Naturalising the geological record

There is a kind of literary evasion here. 'Historical' and 'prehistorical' landscapes may be landscapes of the past but they are always also landscapes in the present, shaped recursively by past and present understandings of time, of landscapes, and of change in landscapes through time. The same applies to features of the landscape, material artefacts of the past, strata, rocks. They might be understood to represent particular past events in the same way as historical texts can: In the spirit of the historian Bronwen Douglas writing about ethnographic pasts, the deep past 'has gone' and exists in the present 'only as "relic", the "present sign of a dead thing" …, in traces of past presents more or less randomly inscribed' or 'preserved' in the case of landscapes and geology.46

In McPhee's text, revealed geology constantly undermines the apparently static sociopolitical, geographical and topographical certainties of lived experience, like 'the nation-state', 'the coast' and 'the Great Salt Lake'. For geologists, and indeed for McPhee, field work represents the beginnings of a journey that above all else is physiographic, a journey that tends to mock the idea of a nation, of a political state, as an unnatural subdivision of the globe, as a metaphor of

the human ego sketched on paper and framed in straight lines
and in riparian boundaries between unalterable coasts … a
terrain crossed with geological boundaries, mammalian
boundaries, amphibian boundaries.47

There is a neat irony in his statement of discontinuity, change with time and
arbitrariness, given the tendency of nation-states to appropriate the physical
evidences of the deep past into celebratory narratives of national essence and
continuity (more on that later).

McPhee's presentation of timescales is itself somewhat reductionist. While
emphasising the disjuncture of scale between lived time and time 'revealed' in the
stratigraphic record, his narrative does not acknowledge time outside a linear
western scientific conception of chronology and he unquestioningly accepted the
broader implications of current geological orthodoxy, even where he allowed space
for the detail of its component hypotheses to be overturned.48 More particularly, he
implied in a number of passages that the geological timescale itself is made up of
somehow natural divisions, neither constructed nor the inherited and adapted
product of a particular phase of geological understanding, namely the middle
decades of the nineteenth century, when the 'geological record' was broadly
understood to show the progressive development of life forms, culminating in
modern western European civil society (Plates 2, 3 and 4). For example, the
Interstate 80 'displays in its roadcuts rocks from every epoch and era' as if those
epochs and eras were intuitively geologically determined from a scientific reality.49

Like Fabian's nineteenth-century social evolutionists who took 'naturalized
Time' for granted, McPhee accepted the stages of the geological record as 'a mere
presupposition of natural history'.50 The major divisions of geological time are
signalled by stratigraphic disruptions like the appearance or disappearance across
the globe of organisms en masse. Gee's approach is useful here. His rejection of
causality and narrative, in the interests of a more rigorously scientific approach to

48 For example, Anita Harris' qualifications regarding plate tectonic theory, *Annals of the Former
50 Fabian, *Time and the Other*, 15.
palaeontology, denaturalises the divisions of 'the' geological record, while retaining them as an accessible shorthand device to show relations in time:51 evolutionary questions, about 'how' and 'why' – are united in implying a narrative in which causes and effects are linked: dinosaurs became extinct because of the after-effects of an asteroid impact, or because they were rendered obsolete by mammals. Chains of cause and effect may also be animated by purpose: fishes evolved legs for walking on land; birds evolved feathers for flight; human beings evolved from ape-like ancestors because they had bigger brains, could make tools, and use language. Popular views of science assume that cause, effect and purpose can be easily discerned.52

Andreas Huyssen wrote in 1995 that 'the specific tripartite structure of past-present-future, in which the future is asynchronous with the past, arose at the turn of the seventeenth to the eighteenth century'. The way late twentieth-century western cultures think about time 'is far from natural' even though it may be experienced as such. This applies equally to lived experience of shallow time (Gee's 'ordinary time') as outlined by McPhee and to his own and 'Geologists' assumptions of the uni-directional linearity of time. Furthermore, this directional aspect is easily confused with progress – both the notion of evolutionary progress against which Henry Gee and Stephen Jay Gould railed, and the notion of scientific progress – that scientific knowledge progresses either gradually by a process of steady accumulation of evidence, or catastrophically, as one false paradigm is overturned by another, more correct synthesis or theory.

As Huyssen put it, 'the move from the past to the future has been linked to notions of perfectibility in social and human affairs that characterize the age of modernity as a whole'.53 He wrote of the accumulation of 'non-synchronicities' in our present, such that 'a very hybrid structure of temporality seems to be emerging'. He meant that disjunctures between the so-called developed and developing worlds,

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51 Gee, Deep Time, 3-4.
52 Gee, Deep Time, 1.
for instance, constitute different times, resonating with Fabian's social evolutionary theorists, who reasoned that dispersal in space reflects 'sequence in Time'.

Huyssen's idea of 'non-synchronicities' can be extended, simplistically, to the ground beneath our feet. Time and change are proved in rocks and landscapes. This is a logical consequence of naturalising geological models, to the extent that a gully or road-cutting becomes a stratigraphic section, and walking 'up-section' along it can be understood as walking through time. As Tom Griffiths put it, writing of George Seddon, 'space and time are indivisible, dimensions of the ground at his feet, and so deep time is not an optional extra but part of the texture and poetry of place'.

Three panoramas from the top tenth of time
I use the word 'panorama' to describe my case studies in the hope that it implies more than an historical study of a particular place at a particular time. Cultural, social, intellectual and environmental histories intertwine at each of these three sites in ways that provide elucidation of the uses and representation of the deep past through its material remains. The rocks, sediments, landsurfaces and landforms preserved there span the Phanerozoic, near enough to the upper tenth of earth history for me to run with the alliteration.

Geological knowledge and the junk-yard of yesterday's orthodoxies
I am wary of representing other narratives that explain(ed) or describe(d) the shape of landscapes as 'wrong turns' or 'false leads'. Apart from anything else, modern geological paradigms are built from a junk-yard of such 'false' leads. Trained as a geologist, I am inclined to believe in the conditional and limited 'truths' that I was taught as a student, and the 'corrections' that have followed. But I cannot say which of these models might prove to be 'false leads' or 'wrong turns' or fabric for the construction of future geological paradigms. So I have attempted to denaturalise some of the modern geological narratives about the case studies, without engaging in a radical deconstruction of the scientific methods and assumptions underpinning their writing. This is achieved by juxtaposing such narratives with other explanations of change in the landscape that do not necessarily correspond to twenty-first-century geological truths but may resonate with or be analogous to

54 Griffiths, 'Deep time and Australian history', 23.
them in various, often unexpected ways.

For example, certain colonial naturalists in the early and mid-nineteenth century proposed the existence of a land-locked sea or freshwater lake system in the centre of Australia, based on a combination of their scientifically-informed reading of the environment, contemporary conventional wisdom about the centres of continents, and wishful thinking. Eventually South Australian colonists discovered the Lake Eyre basin, which may represent (according to modern geological ideas, and to diminish a scenario of irreducible complexity to a few inadequate words) the teasing, ephemeral, salty remnant of a giant lake system, and before that, an ancient intracratonic sea.

The Kaurna people of the Adelaide Plains explained the presence of freshwater springs along the coast south of Adelaide with recourse to the tears of an old man for his nephew. That there are, or have been freshwater springs flowing from the Mount Lofty Ranges to the coast during the Holocene epoch is not in question. The Kaurna account explains current landscape activity through the lens of the past actions of ancestors. It is causal without necessarily being teleological. Secular geomorphological models work the other way, attempting to refine past processes from their present manifestation. They tend to be synthesising and generalist rather than localising, functional and intimate.

Pastoralists and surveyors in western New South Wales and northern Victoria occasionally found fish bones and freshwater mussel shells on the oval saltbush plains interspersed among the dune fields of the mallee country. Some of them interpreted these as signs of former freshwater regimes in the now semi-arid country, speculating that the plains once were lakes. During the mid-twentieth century and into the twenty first, geomorphologists used these fishy remains and other evidence to construct a deep past of great climatic oscillations in these landscapes during the Pleistocene epoch (from about two million to about ten thousand years ago), between dustbowls and well-watered lacustrine oases.

These narratives are all inter-related. Modern geoscientists do not have privileged access to the knowable, real, unmediated deep past. Like all of ‘us’, ‘they' construct pasts from ill-fitting relics in the present. They have the conceptual equipment and the learned responses to identify material remains of the past with more or less precision according to modern geological paradigms. But these are recursive. They extend, revise or rehearse older narratives, influenced by the same
data that informed other, incompatible ways of knowing about country. It is only from within and with hindsight that they appear authoritative, revolutionary or inevitable.

To borrow from the environmental historian Stephen Pyne, each of the places I have chosen has political and cultural meaning beyond the material 'reality' of its geomorphology, human remains and marsupial bones.55 Australian geologists, vertebrate palaeontologists and archaeologists regard each of these areas and the suites of stories associated with them as more or less canonical.

Canonical landscapes and contested pasts
The thesis is unevenly divided into three main sections, or thematic panoramas. Each section unfolds around the revelation of a landscape's deep past in the instant of its scientific discovery, the 'making' of a deep history akin to what Walter Benjamin, describing historical materialism, called 'that image of the past which unexpectedly appears to man singled out by history at a moment of danger'.56 These emblematic encounters are thrown up at us from the annals of the earth sciences as the stunning, introductory, public moments that define and preface the heroic pasts of the discipline, as well as representing the emergence of 'knowledge about' the deep past at a particular site.

Such moments and such sites are subject to contest. At Hallett Cove the details of Ralph Tate's discovery of glacial pavements in 1875 or thereabouts are cloudy, but the site's age proved contentious. At the time, the notion of Australian glaciation itself was deeply controversial, and many of his contemporaries questioned Tate's identification of the cove landforms as glacial, as well as his claim of their Pleistocene or Recent origin. Eighty years later urban planners and land developers challenged geologists' moral claims to the landscapes of the cove. Conservation battles fought from the 1960s to 70s redefined South Australian public and institutional ideas of geological heritage and value in a landscape.

At Lake Callabonna the first western scientific encounter with the lake's deep past was itself contested. Who found the bones? What constitutes discovery in the context of vertebrate fossils? Who do the bones 'belong' to? What about their stories? Longstanding questions about the marsupial nature of the giant extinct

56 Benjamin, Illuminations, 257.
mammal *Diprotodon* could be resolved, but questions about the familiarity of Aboriginal people with the living animal and hence about human antiquity and origins in Australia remained insoluble. The lake challenges conventional notions of value, beauty and richness and its deep past reveals a potential apparently unrealised in its 'desolate' modern landscape.

Lake Mungo's 'moment of danger' made it a multiply-contested site. Discovered by a geologist, archaeologists appropriated the first evidence of its long human past. Aboriginal people in turn dispute academic ownership and interpretation of the material culture and human remains. Leasehold claims by pastoralists in the region add a further layer of complexity to negotiations about ownership, belonging, tradition, heritage and knowledge in an already over-determined landscape, ravaged by salt, wind, water and sheep, but treasured for its wealth of pasts.
Chapter II

Historicising the land

Chapter Two divides into two sections. The first considers canonical stories relating to Lake Callabonna, Hallett Cove and the Willandra Lakes, recorded in disciplinary histories which have mostly been written by earth scientists. The second section deals with collective identity and the deep past. It discusses the claim that the appreciation and celebration of Indigenous histories and the non-human prehistory of the continent are a form of nationalistic appropriation, in the interests of legitimising Australian national identity.

'History' as background noise

The stories that constitute the case studies are not by any means unknown. Among vertebrate palaeontologists and geologists in particular, there have been regular attempts to document and publicise the histories of their disciplines, societies, university departments and institutions in Australia. Perhaps this historical consciousness stems partly from the narrating possibilities of the scientific discourses themselves. The epistemological as well as historical roots of the geosciences lie in fieldwork. Fieldwork and exploration – adventures in place as well as time – endow the disciplines with a gung ho, Boys' (and Girls') Own mystique. Furthermore, field geologists make 'field notes' in a notebook or journal – which then provides a sequential mnemonic to a field trip. They develop a storytelling habit.

The archaeology of palaeontology

There is an important but hazy distinction between historical reconstruction which

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2 For example, see Martin Rudwick, 'Geological travel and theoretical innovation: The role of "liminal" experience' (Historic paper), Social Studies of Science 26, 1996 (1978), 145.
might be necessary for scientific purposes (for example, relocating field sites, reclassifying fossils, demonstrating their provenance) and mythologising or historicising the discipline. For example J W Gregory, who was the Professor of Geology and Mineralogy at the University of Melbourne at the beginning of the twentieth century, used the published papers and field notes of H Y L Brown, the Government Geologist of South Australia, when choosing routes and destinations for his summer field trip of 1901-2 to the Lake Eyre basin. On the mythologising front, Gregory subsequently published *The Dead Heart of Australia*, a lively, detailed, popular account of his own expedition, which made light of the rigours of fieldwork on camel-back in temperatures of 40°C, while celebrating geology as both an adventure and an essential nation-building exercise. However, it became an important palaeontological (or perhaps 'palaeontographic'?) resource as well, like Brown's accounts of a decade earlier.

In 1958 Ruben Stirton, an American palaeontologist on location in South Australia, found a copy of *The Dead Heart* in an Adelaide library. He and his companions took Gregory's book and Brown's report with them into the field, partly retracing Gregory's footsteps along the Cooper Creek and Warburton River. Stirton banked successfully on finding Tertiary mammal fossil sites close to the places Gregory and Brown had found fossil crocodile and turtle bones.

Four decades later, Stirton's former student Richard (Dick) Tedford and an Australian colleague, Rod Wells, published an article which re-examined Pleistocene fossil vertebrates from the Lake Eyre basin. Invoking Gregory's trope of the 'dead heart' in their title, they provided a scholarly historical overview as well as a scientific synthesis of field work in the region over the previous century. Similarly in 1995, accompanying their examination of extinct sthenurine kangaroo skeletons from Lake Callabonna, Wells and Tedford described one hundred years

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4 R A Stirton, Field journal 1958, South Australia (UCMP Collection).

of field work at the lake. Such historical summaries are generally intended to aid future workers in the region, or to demonstrate the provenance of fossils.

On the other hand, Stirton's account of his and Tedford's earlier South Australian expedition, in the excitedly titled Pacific Discovery journal, is in the mythologising tradition of Gregory's book, depicting palaeontology as an adventure. Dick Tedford also wrote popular accounts of this and later expeditions in Australia, beginning with 'The Diprotodons of Lake Callabonna' in 1973, which was published in Australian Natural History, an entertaining rendition of his two expeditions to Lake Callabonna over the previous quarter-century. He provided chapters about 'the American contribution' to vertebrate palaeontology in Australia during the second half of the twentieth century in two weighty edited collections by Patricia Vickers-Rich, a Berkeley-trained palaeo-ornithologist from Monash University. These articles celebrated the earth scientist – and specifically Ruben Stirton – as adventurer, in the spirit of archaeologists Arthur Evans and Heinrich Schliemann in the Aegean, or even Indiana Jones. J W Gregory was himself the model, in a series of children's books, for Osmar White's deranged Scottish adventurer-geologist, Dr A A A McGurk, who set off on camel-back for the dread Deadibones Desert in search of the Super-roo of Mungalongaloo.

The most recent historical word on Callabonna comes from another colleague of Wells and Tedford, Neville Pledge, curator of vertebrate palaeontology at the South Australian Museum. In 1993, at a conference celebrating a century of expeditions to Lake Callabonna, Pledge delivered a paper documenting the history of vertebrate palaeontology there, beginning with an account of the discovery of the first Diprotodon remains to reach Adelaide in

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1892.\(^{10}\) But as well as celebrating and documenting vertebrate palaeontology in Australia, the articles above, and much of the popular palaeontological writing by Vickers-Rich and her husband Tom Rich, of the Melbourne Museum, is designed to serve a pedagogical purpose. Their histories are often quite deterministic, but nonetheless emphasise the contingency of field sciences, dependent both on the fortuitous preservation of material remains and on their discovery for the creation of palaeontological knowledge.

The major contributions to Callabonna historiography from non-scientists come from Hans Mincham and from Margaret Ragless. Mincham, a writer and former Information Officer at the South Australian Museum, wrote his popular account of extinct Australian megafauna, *Vanished Giants of Australia*, in 1967, with a chapter dedicated to Diprotodons and in particular to the museum’s involvement with the Callabonna fossils. Ragless' family history, *Dust Storms in China Teacups*, devoted a chapter to Frederick Brandis Ragless, the alleged discoverer in 1892 of the Callabonna fossil site.\(^{11}\)

These stories are no more reliable for being oft-repeated. Men and women who presumably would not dream of taking shortcuts with their stratigraphies can become remarkably slipshod when it comes to historical documentation. Generally concerned to document the inevitable progression of knowledge or disciplinary maturity within a particular cognitive community, they may invoke Thomas Kuhn or George Basalla, often unselfconsciously and simplistically, to demonstrate the relationship through time of palaeontological data, theory and knowledge.\(^{12}\) The nuances of older or alien paradigms are relegated to footnotes, quaint euhemerism, or used to bolster a view in which palaeontology 'progresses' from catholic, ad hoc and undisciplined to objective and scientific – that is, self-regulating and

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\(^{10}\) Pledge, 'Fossils of the lake', 65-77. The forum was the fourth conference on 'Australasian vertebrate evolution, palaeontology and systematics', held in Adelaide in April 1993.

\(^{11}\) Hans Mincham, *Vanished Giants of Australia* (Adelaide: Rigby, 1967), 38-56; Margaret E Ragless, *Dust Storms in China Teacups: Ragless Family Heritage to Australia* (Adelaide: Investigator Press, 1988), 85-97. Margaret Ragless derived the bulk of her information regarding the discovery of the Callabonna fossil field from Fred Ragless’ memoir, which he mostly wrote during the last two decades of his life, from 1936 to 1953 (F B Ragless, 'Seventy years ago: The journal of Frederick Brandis Ragless', nd, unpublished MS [private collection of Margaret E Ragless]), and from newspaper cuttings and photographs collected by Fred Ragless.

specialised. In most of the 'historical' accounts of scientific involvement with Lake Callabonna referred to above, 'History' is a sort of background noise to affectionate, personal chronicles of scientific encounters with a landscape.

*Hallett Cove as an artefact*

South Australian geologists have made something of an industry of telling stories about Hallett Cove, but before 1960 they mostly related to its geology. Occasionally the site made it into a disciplinary history, as in a 1936 centenary address to the Royal Society of South Australia by Sir Douglas Mawson detailing 'Progress in knowledge of the geology of South Australia', in which the author dedicated a page to Ralph Tate's discovery of the glacial pavements in 1875 or 76, and subsequent scientific developments. Only when the cove was re-zoned from rural to residential in 1962, and geologists recognised the imminent threat to its striking geological and geomorphological features, did the interesting history of scientific investigation there feature as much more than a curious footnote.

In 1967, writing of his own experiences in the Geology Department at the University of Adelaide, Arthur Alderman, Professor of Geology and Mineralogy from 1953 until 1966, briefly discussed the early scientific history of Hallett Cove, but ignored his role in the battle to save it from housing development since 1958. In the late 1970s the historian of geology David Corbett touched on the history of scientific investigation at Hallett Cove in biographies of Ralph Tate and Walter Howchin, which formed part of a series of 'Profiles of famous Australian geologists' that he wrote for the Field Geology Club of South Australia, an association closely connected with the protection of geological features at the cove. The South Australian Museum published a guide book, *Hallett Cove: A Field Guide*, in 1970, which dealt briefly with the post-1836 history of Hallett Cove. It included extensive chapters on the geology, archaeology and botany of the site. Two decades later the Field Geology Club published a guide to the geology

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13 D Mawson, 'Progress in knowledge of the geology of South Australia', *Transactions of the Royal Society of South Australia* 60, 1936, lxiii.

14 Alderman, 'The development of geology in South Australia', 32, 33.


of Hallett Cove, in the spirit of the museum's booklet, but non-geology was relegated to a page of the introduction.¹⁷

Barry Cooper, a geologist who has been heavily involved in the protection of geological heritage in South Australia, delivered a paper to the Friends of Hallett Cove in 1992 which outlined the history of scientific investigation and protest at the cove.¹⁸ The indefatigable Adelaide geologist Maud McBriar wrote about the twenty year battle for the conservation of Hallett Cove as a geological monument in 2000, in an entry in the University of Adelaide's Records and Reminiscences, an account of 125 years of geosciences at the university. In 2001, she co-authored a short account in the National Trust of South Australia's journal, Heritage Living, outlining the trust's role in the cove's eventual protection.¹⁹ She also contributed to a number of unpublished reports during the 1960s and 70s outlining Hallett Cove's geological and historical significance.

Most of the non-geological writing on Hallett Cove between 1958 and 1975 related to contemporaneous efforts to prevent housing development from compromising the geology of the coast and hinterland. They are contemporary accounts of an ongoing problem. Subsequent writing about the area memorialised the conservation battle and the roles of the National Trust of South Australia, professional bodies like the Geological Society of Australia, the University of Adelaide and the South Australian Science Teachers Association (SASTA), groups like the Field Naturalists' Club and the Field Geology Club of South Australia, and the Friends of Hallett Cove, and a number of individuals. Alison Dolling included a short section on Hallett Cove in her local history of Marion Shire, The History of Marion on the Sturt.²⁰

The only thorough historical synthesis of scientific investigations at the

cove in the context of wider ideas about glaciology, climate change and landscape evolution appears in H J Scott's history of Australian geomorphology, *The Development of Landform Studies in Australia*, published posthumously in 1977. Even so, Scott's chapter on the study of the evidence for glaciation in Australia devotes just a few pages to Ralph Tate's discovery and the ensuing debate. Scott dealt with 'the first geomorphological controversy: glaciation in Australia?' in some detail, but he did not write much about twentieth-century investigations at the cove, nor about the conservation battle of the 1960s and 1970s.21

In a sense the history of glaciology at the cove is a 'dead' history. It is at first sight a story about the triumph of scientific method, as hypotheses were progressively tested and discarded until geologists reached a provisionally 'right' answer regarding the age and origins of the features, notwithstanding the odd 'false lead' during the 1880s and 1940s. During the 1960s, the celebration of this history, together with the importance of the cove as a teaching resource, helped save part of it from development, and this history of protest has a small literature in memoirs, unpublished reports and in-house journals and magazines. But since the 1960s, geology at the cove has been seriously compromised as suburbia continues to encroach, even to the edges of the conservation park. South Australian geologists and science teachers still use it as a teaching resource, but it seems there is not much new to be learned from the reserved area, and no opportunity for digging up private houses and backyards simply to extend geological knowledge at the cove.

*Writing the meaning of Mungo*

Despite its unparalleled position in the history of archaeological investigation in Australia, the Willandra Lakes system has largely escaped disciplinary histories. A notable exception is the CD-rom, *Lake Mungo: Window to Australia's Past*, by Jim Bowler, produced in 2002 by the University of Melbourne and the Murray Darling Basin Commission. Bowler included a substantial and very personal recent history of Lake Mungo. But not much new was written about it all between 1986 and 1997.22 In 1998, a special edition of *Archaeology in Oceania* set out to remedy this


22 However, Lake Mungo regularly raised a mention in archaeological text books, for instance in Josephine Flood's *Archaeology of the Dreamtime* (Sydney: Collins, 1983 [revised editions 1988, 1990, 1991, 1995, 1999]) and John Mulvaney and Johan Kamminga's *Prehistory of Australia* (Sydney: Allen & Unwin, 1999). It is one of several sites synonymous with Australian archaeology
want. As Wilfred Shawcross wrote (somewhat depressingly) in one of his contributions to the collection,

As a quarter of a century has passed since these Mungo excavations were commenced … it becomes necessary to consider the investigations themselves through an archaeology of archaeology. After all, there is now a generation of graduates who could nearly be the grandchildren of the investigators, and who may have ideas about the meaning to be derived from Mungo quite different from those original workers. Indeed, if L P Hartley's perceptive novel The Go Between, which introduced the phrase 'the past is a foreign country' is considered, the investigators and their insights into what they themselves were doing will have changed also. Furthermore, in a lifetime of archaeology one has heard so much scolding over why one, or another, had not promptly produced the definitive report on an investigation, or that, on the other hand, the publication of a monograph, representing twenty years of toil after fieldwork, which at the time had seemed precariously on the frontiers of knowledge, is so frequently received derisively as an intellectual anachronism. The implications of such changing perspectives deserve to be considered.\(^\text{23}\)

The archaeologists Harvey Johnston and Peter Clark published the first synthesis of archaeological investigations at the lakes in this issue. Shawcross, Jim Bowler and Harry Allen also contributed chapters with historical or historiographic ('archaeographic'?!) content.\(^\text{24}\) The collection was indeed a timely intervention,


given the publication the next year of a revised and highly contested date for the human burial named Lake Mungo 3, or 'Mungo Man', of upwards of 56,000 years.

Two emblematic moments for Australian archaeology at Lake Mungo are Bowler's discovery of the bones of the Mungo 1 cremation in late 1968 and their collection in John Mulvaney's suitcase a few months later. Mulvaney's suitcase is now on permanent display in the National Museum of Australia. In another transformative episode a quarter of a century later Alan Thorne, the physical anthropologist at the Australian National University who reconstructed Mungo Lady in 1969, gave these remains to Aboriginal elders in a moving ceremony on the lakeshore in 1992.

In 1997, Nicholas Jose published *The Custodians*, converting the discovery and handback of Mungo 1 into a novel about personal and collective national identity rather than a story about the making of archaeological knowledge and the deep human past in the western Riverine Plains. In the process, he elided or overlooked much of the nuance and excitement of the history of the discipline, of the public scientific acknowledgement of Aboriginal longevity and of change in the landscape, dispossession of pastoralists, and ongoing contest over the disposition of the material remains of the human past. The Willandra Lakes landscapes may be overdetermined, but in historiographic terms they are under-written.

So what does my re-focus contribute to any of these histories? Like the landscapes, these stories are canonical. Indeed they are part of the cultural accretion, including social, political, economic and scientific layers, through which a particular landscape and a particular time are made meaningful. Taking Stephen Pyne's 'short' history of the cultural and scientific invention of the Grand Canyon, *How the Canyon Became Grand*, as a much-admired theoretical launching place, this thesis reviews and revises canonical stories about three celebrated scientific episodes, in an investigation of the invention of meaning and the investment of scientific value in a landscape. John McPhee's epic *Annals of the Former World* offers a trans-continental perspective on the interpretation and articulation of contemporary geological ideas about the interrelations of science, time, sediments, climate and subsurface activity.

McPhee and Tom Griffiths' *Hunters and Collectors* ably demonstrate different ways of theorising the interpretation and use of the deep past through the lens of a particular disciplinary history: respectively North American geology and
Australian archaeology and antiquarianism. Paul Semonin's *American Monster* provides another approach to the investigation of the interpretation and mobilisation of deep time. He examined one North American-specific example of the imaginative expropriation of the material remains of the non-human past to embellish Anglo-American claims to the North American landscape. Martin Rudwick's work has been tremendously influential, alongside Donald Grayson's book *The Establishment of Human Antiquity*, especially as they relate to the history of ideas about change in the landscape and the origin and distribution of species during the nineteenth century.

**Nationalism, identity and deep time**

British success in Australia ultimately required that settlers overcome the sense of strangeness and alienation with which many of them regarded the countryside. Their control of the continent required first knowledge about, then cultivation of the land, from which colonists could derive the sense of 'belonging in' the places they had alienated which was critical to the development of local identity. They celebrated Australian landscapes for their supposed resemblance to British countryside, for their productivity or potential. However identity is always exclusive as well as inclusive, manufactured against something, and to an extent it needs to be accepted by outsiders as well as insiders. So the strangeness of Australian landscapes, climate, exotic flora and fauna have been important components of the construction of white Australian identity 'since the nineteenth century', as David Carter pointed out in 1995.

**'Indigenisation' and national identity**

If recent history was not enough to authorise and articulate a particular, cohesive

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Australian identity, then is it extraordinary that the appropriation of indigenous prehistory emerged as a legitimising tactic for the expression of an evolving national persona? In 1996, the archaeologist Denis Byrne found it 'unsurprising' that 'in order to bond itself better to the exotic terrain by sending roots down into the continent's past', white Australia 'would at some stage want to appropriate to itself the time-depth represented by the archaeological remains of the indigenous minority'. Likewise, David Carter argued that during the twentieth century, recognisably Aboriginal landscapes increasingly came to represent distinctively 'Australian' national landscapes, Philip Batty wrote of 'Australia's desire to know itself through Aboriginal cultures' and Ian McLean suggested in 1998 that 'Aboriginalising' discourses of Australian identity first occurred 'over sixty years ago' when many Australians 'suddenly developed a life-long fascination for the desert and its indigenous inhabitants'.

In the early to mid-nineteenth century, it was enough to regard Australian landscapes as wild and new, hitherto providentially ignored by civil society to produce a clean slate for Englishmen to cultivate in the image of the Old World. Initially the imposition of Eurocentric place-names helped familiarise and domesticate some of these landscapes. Perhaps colonial discomfort as well as pragmatism led to a fashion for Aboriginal or Aboriginal-sounding names.

29 Denis Byrne, 'Deep nation: Australia's acquisition of an indigenous past', Aboriginal History 20 (1996), 82.
32 For example, see E C Stirling, 'The recent discovery of fossil remains at Lake Callabonna, South Australia', Nature, 50, 1894, 185: 'There prevails a very proper sentiment, unfortunately not always carried into action, that the native names of localities should, so far as possible, be retained'. Stirling was arguing for the retention of the name 'Callabonna' over the demotic name, 'Mulligan', for the
Furphy, an historian, read this proclivity for indigenous-sounding place-names, often removed of context, as part of the (ongoing) colonial imperative to shape settler identity which David Carter labelled ‘indigenisation’. The plethora of Australian place-name books published in the twentieth century, which gave a sort of legitimacy to settler places by historicising European and ‘indigenised’ place-names, continues this trend. McLean determined that 'if Aborigines now returned as icons of an Australian identity' during the mid-twentieth century, it was as colonised rather than postcolonial.

Recent histories of Australian nationalism and nation have examined this appropriation over the last two hundred years of Aboriginal language, culture, landscapes and heritage to enrich national identity. With the gradual revelation of Australia's deeper pasts, specifically its human pasts, and ultimately the Aboriginal influences on the ecological disposition of the continent, the legitimacy of a nation founded on the pragmatic decision to ignore prior Aboriginal ownership comes into question. European association with the continent is by 'historical accretion' rather than birthright.

On the one hand, as Kirsty Wehner wrote in 1999 in response to comments at a workshop on environmental history at the National Museum of Australia, any

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36 Peter Christoff, 'Naming rights in an unsettled land', *Age, Saturday Extra*, 27 April 2002, 8.
discourse of collective national identity espouses 'a "natural" connection between the land and the people who occupy it'. This is particularly problematic in the case of the Australian nation-state, because Arthur Phillip's arrival at Sydney Cove in January 1788 provides an unambiguous signal and an irresistible emblem for the first British colonial encounter with the continent and its productions. Therefore for non-Indigenous Australians, 'there can be no "lost in the mists of time" connection with the landscape'.37 On the other hand, 'Indigenisation' gives white Australian places historical relevance beyond 1770, and arrogates Aboriginal places into the national past until 'one of the newest societies on earth is given one of the longest histories'.38 Similarly, while McLean's 'Aboriginalism' can be seen as an attempt to redefine white Australian identity through 'metaphors of Aboriginality rather than ones of empire', he contended that it is an 'arguably assimilationist' rather than a 'genuinely hybrid' model, incorporating rather than engaging with Aborigines.39

Stealing the past
One step beyond 'Aboriginalism' is deep time. David Ride wrote in the mid-1980s of Australian fossils that 'the remains of our earliest past also tell of the past history of the world'.40 The celebration of Australia's Gondwanan links, Western Australia's living and fossil stromatolites and its Precambrian surface geology, the Wollemi Pine of the Blue Mountains, possible vertebrate ancestors in the Flinders Ranges, territorial disputes over the 'nationality' and the identity of (putatively) the oldest mammal remains yet found in the world or in Australia (in Cretaceous rocks in south-eastern Australia and early Eocene rocks at Murgon in Queensland),41 Victoria's Dinosaur Cove, and other markers of non-human antiquity in a landscape vindicate the geochronologist M J Aitken's assertion that, even amongst scientists, 'the importance of a site is often much enhanced by dates of great antiquity'.42

37 Kirsty Wehner, 'Comments after the fact', in Robin and Wehner, 'Environmental history in the National Museum of Australia', 55.
39 McLean, 'Post colonial: Return to sender'.
40 Ride, Preface, in Rich and van Tets, eds, Kadimakara, 9.
42 M J Aitken, An Introduction to Optical Dating: The Dating of Quaternary Sediments by the Use
International concern about the illegal removal of fossils and other markers of age from dedicated reserves, and their black market trade across borders, is another case in point, illustrating the kudos accrued by nation-states from the material remains of the past. Dr Jim Gehling, an invertebrate palaeontologist at the South Australian Museum, recently noted in the context of the trade in antiquities, that 'Anything that is rare and ancient has value. So when you are talking about some of the oldest and rarest fossils on earth, that creates enormous problems'.

Gehling is himself anxious about the vulnerability to poachers of the Pre-Cambrian sites on which he works in the Flinders Ranges. The Ediacara Fossil Reserve, near Leigh Creek in the Flinders Ranges, was proclaimed in 1958, and contains an incredibly diverse range of fossils of soft-bodied, multi-celled specimens, dating from roughly 600 million years ago. Reg Sprigg, then a geologist at the University of Adelaide, first found the mysterious fossils in 1946 in the Ediacara Hills. Since the 1960s, the sites, which are in fact not local to Leigh Creek and are scattered throughout the Flinders Ranges, have been regularly ransacked by collectors and dealers as well as studied by professional palaeontologists.

Famed for its soft-bodied fossil organisms, the region has most recently been prominently in the media since the leaked announcement of the identification in October 2003 of a fossil thought by Gehling and others to be an early chordate dating to more than 560 million years ago. Gehling added that 'There is a black market in all antiquities whether it be archaeological earthenware from the Mediterranean, to these [Ediacaran fossils]'. The value of fossils and other material remains of the past on the black market is based less on their scientific importance than on their antiquity and scarcity: 'Anything that is very old and rare is marketable to the private collections of the unscrupulous rich or the public

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43 Penelope Debelle, 'Fossil discovery a magnet for raiders of the primordial ark', Age (Melbourne), 25 October 2003.


45 The phylum chordata incorporates animals of the entire subphylum vertebrata, including fish, amphibians, reptiles, birds and mammals. Their primary defining feature is a notochord or a vertebral column running along the dorsal surface of the organism from head to tail. The earliest probable chordate fossil found prior to the Flinders Ranges specimen is from China and dates to 535 million years ago. The Ediacaran fossil superficially resembles a large tadpole.
collections of shadier museums'.

With regard to these remains and other 'environmental heritage' requiring protection, the South Australian Department for the Environment and Heritage (then Environment, Heritage and Aboriginal Affairs) recently discussed 'maximising return' on the State Government's 'investment' in 'natural capital'. The furore over the illegal removal of fossil material, with its concomitant threat to 'our fossil heritage', has reached legislative ears. The Commonwealth Protection of Movable Cultural Heritage Act (1986) allows a maximum penalty of five years in gaol and a $100,000 fine. In 1996 the State Heritage Board of South Australia announced specific new penalties for the theft of fossils from the Ediacara Fossil Reserve which included gaol terms of up to four years and fines of up to $15,000. The maximum fine can be imposed for each fossil taken or damaged. However, recent controversies over the disposition of the material remains of the past problematise the high moral ground claimed by many professional palaeontologists and archaeologists in Australia and abroad.

For instance, in a famous case in North America in 1992, 'Sue' was then the largest and most complete Tyrannosaurus Rex ever recovered. Her discoverers at the Black Hills Institute of Geological Research in South Dakota, a private establishment specialising in supplying 'professionally prepared' fossils, casts and mineral specimens to museums and educational bodies, displayed the dinosaur in their museum. But 'Sue' was also claimed by the landowner Maurice Williams, a Native American rancher (who had sold the fossil to the Black Hills Institute), by the US Government, and by the Cheyenne River Sioux within whose reserve Williams' land title fell. Armed Federal agents raided the museum at Hill City where Sue was displayed on 14 May 1992, and protracted legal proceedings followed. Sue – the 'Marlene Dietrich of fossils' – now resides in the Chicago Field Museum of Natural History, having been purchased at auction by that institution for an unprecedented US$8.36 million in 1997.

46 Debelle, 'Fossil discovery a magnet for raiders'.
48 Reynolds, 'Fossil thefts'.
50 Steve Fiffer, Tyrannosaurus Sue: The Extraordinary Saga of the Largest, Most Fought Over T.
The Black Hills Institute claims that as a fossil collection agency, it is performing a public service, in the face of criticism, obstruction and occasional persecution from professional vertebrate palaeontologists and bureaucrats. Representatives of the institute have pointed out that Sue, and other less spectacular fossils, might never have been found were it not for the work of BHI and other similar agencies. If not for amateur and private collectors, valuable indicators of past environments and antiquity in the landscape would weather away and be lost to science and the public. The Society of Vertebrate Palaeontologists refutes these claims of 'the public interest', stating that while fossils are part of the national heritage, to be shared by all Americans, it is essential that they remain undisturbed in the ground until trained scientists can assess their significance and ensure their provenance, and it is immoral to tolerate a market in antiquities, implicit in the activities of private collectors.51 Other palaeontologists claim that the publicity surrounding the price fetched at auction for Sue by Maurice Williams may have 'inspired a new generation of fossil thieves', and 'may be the single most damaging action in the history of vertebrate palaeontology'.52

Wherever the moral high ground lies, it is clear from the enduring preoccupation with fossils and their regulation that age in the landscape is regarded as a cause for national pride, perhaps a unifying hook on which to hang parochialism and identity. The control of knowledge about the past and the disposition of antiquities are regarded, by scientists, legislators, collectors and their publics, as important for the generation of national heritages and the consolidation of national identities.

In Australia, concerns about the use of low level explosives by scientists at the World Heritage listed Riversleigh fossil reserve in Queensland, and debates between researchers and National Parks and Wildlife Service (NPWS) staff at its

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52 Fiffer, *Tyrannosaurus Sue*, 215, 212.
sister reserve at the Naracoorte Caves in South Australia demonstrate that such ambiguities and demarcation disputes are not limited to the United States.\textsuperscript{53} The Ediacara chordate fossil's discoverers, Flinders Ranges local Ross Fargher and his wife Jane, highlighted the issue of the control and ownership of non-human remains of the deep past with their concern that local fossils remain local. Fargher told the \textit{Age} newspaper that they 'do not want to see local fossils vanish into city museums', contending that palaeontologists 'only need so many to study. I think [the fossils] are better off in the field'. In this context, the Farghers regard metropolitan scientists as a necessary evil. Fossils like the chordate 'proved the Flinders Ranges were among the most amazing places on earth'.\textsuperscript{54} Local, rather than state-wide or national, identity requires that valuable fossils remain \textit{in situ} or in local institutions, as value in the landscape is encoded in the signs of age found therein.

In contrast, Henk Godthelp of the Australian Museum pointed out in 2001 that 'A fossil is really just a lump of rock until you extract it, prepare it, identify it and tell its story'.\textsuperscript{55} In Godthelp's view, the work of palaeontologists in proving the rareness and age and provenance of fossils imbues them with value. Without their scientific context, they would be largely worthless as objects of veneration, commerce or regional identification.

\textit{Putting down roots}

The Antarctic explorer Charles Laseron wrote the best-selling \textit{The Face of Australia} and \textit{Ancient Australia} in the 1950s.\textsuperscript{56} Four decades later Simon Schama traced the 'ferocious enchantment' of national identity to the 'mystique of a particular landscape tradition'. Geography, 'mapped, elaborated, and enriched as a homeland', in turn helps define the contours of national identity.\textsuperscript{57} Laseron's introduction to \textit{The Face of Australia} could have been Schama's exemplar:

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54 Penelope Debelle, 'Fossil could be backbone of man's beginnings', \textit{Age} (Melbourne), 23 October 2003.

55 Hoy, 'Picking bones'.

56 Charles Francis Laseron, \textit{The Face of Australia} (Sydney: Angus and Robertson, 1953); idem, \textit{Ancient Australia: The Story of its Past Geography and Life} (Sydney: Angus and Robertson, 1954).

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To those who have put down roots in the soil, what the pioneers found unattractive now binds us to the country. The unfamiliar has become the familiar; it has become part of us and we of it; it is the spirit of our national pride, the basis of our love of country.58

Laseron wanted the highly urbanised Australian public to engage with Australia's varied and ancient landscapes. He sought a new denotation of landscape beauty, which could encompass the 'strangeness' of Australia. In 'so many lands', the post-glacial and alpine landscapes of North America and western Europe for example, or the rugged, tectonically excitable scenery of northern California, scenic beauty 'is an attribute of youth'. In Australia, by contrast, 'it is expressive of great age':

Its contours speak of vast antiquity, of long eras of stability, of freedom from the cataclysms that are still changing the shape of other countries. Even animals and plants, developed in long isolation from the outside world, are different.59

Like Laseron, Hans Mincham appealed to and celebrated the material remains of the deep past as a national resource. He regarded it as crucial that his book about Australian Pleistocene mammals, *Vanished Giants of Australia*, reach a wide non-specialist audience, children as well as adults.60 Published in 1967, *Vanished Giants* revisited many of the heroic foundation myths and 'moments of danger' of Australian vertebrate palaeontology. Mincham commemorated as heroic not only the serendipitous discoveries and the planned expeditions to inhospitable locations, but the painstaking imaginative task of recreating an extinct animal from fragile, disarticulated bones. His book celebrated vertebrate palaeontology as a noble and national endeavour, locating national pride in the material remains of a deep, non-human past.

Aboriginal oral traditions are also appropriated into the shared archive of nationally significant cultural productions. The 'folk-tales' of Mary Grant Bruce, Katherine Langloh Parker and others, incorporated into a trans-cultural corpus of

tradition and literature that includes imported Anglo-Celtic cultural baggage, historical and semi-historical figures like Peter Lalor, Breaker Morant, Simpson and his donkey, Don Bradman, the Man from Snowy River, Ned Kelly and Captain Thunderbolt, and the Gum Nut Babies and Banksia Men of May Gibbs, provide non-Aboriginal Australians with stronger links with the landscape, further legitimising white Australian nationhood.61

When A W Reed emphasised the value of absorbing Aboriginal oral traditions into 'the literature of Australia' to strengthen the engagement of the immigrants with their new home, he used a somewhat tired horticultural metonym. He wrote in 1965 that non-Aboriginal Australians cannot 'put our roots down into the soil' without first incorporating Aboriginal 'folklore' into 'the indigenous literature of the southern continent' so that we can at last understand the land 'through the eyes of the primitive, clever, imaginative people who had to fight to gain their nourishment from Mother Earth'.62 Bruce, less flatteringly, represented her 'folk-tales' as the last remnants of a doomed people, a curious legacy to the conquerors:

The folk-tales of a people are the story of its soul, and it would be a pity if the native races of our country were to vanish altogether before we had collected enough of their legends to let their successors know what manner of people lived in Australia for thousands of years before the white man came.63

These 'traditions' are de-historicised and exclusionary. They are part of the celebration of a nationhood that is white, male and Anglophone.

At a conference at the Australian Institute of Aboriginal Studies (now AIATSIS) in 1972 on the 'Preservation of Australia's Aboriginal Heritage', the exploitation of Aboriginal culture was still on the agenda. However well-intentioned, and for all that the published conference proceedings stressed the

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61 For example, Mary Grant Bruce, The Stone Axe of Burkamukk (London and Melbourne: Ward, Lock & Co. Ltd, 1922); K Langloeh Parker, Australian Legendary Tales, ed. and selected by H Drake-Brockman (Sydney: Angus and Robertson, 1953 [1896]); W Ramsay Smith, The Myths and Legends of the Australian Aborigines (George G Harrap & co, 1930); A W Reed, Myths and Legends of Australia (Sydney: A H & A W Reed, 1965).

62 Reed, Myths and Legends of Australia, 9.

63 Bruce, 'Foreword', in The Stone Axe of Burkamukk, 6.
intrinsic beauty and 'value' of Aboriginal cultures and cultural productions, the
necessity to protect them, and to integrate them into 'Australian history', they were
represented as national and international resources. For example, the conference
convener and editor of the proceedings, Robert Edwards, who was then the curator
of Anthropology at the South Australian Museum, stated in his introduction that
'Every nation in whose territory there are monuments, antiquities and sites of
national importance has an obligation to safeguard this part of mankind's cultural
heritage and to ensure that it is preserved for future generations'.  

In the final session of the conference, on 'Sacred sites and the Aboriginal',
Ian Leggoe, a management consultant, provided 'an economist's viewpoint' on
Aboriginal involvement in central Australian tourism. He pointed out that
Aboriginal oral traditions had an invaluable role to play to 'enhance' the tourist
experience: 'Once … tourists reach central Australia then it is possible to provide a
highly interesting and uniquely picturesque tour based on the natural scenery and
the Aboriginal myths associated with the landscape'. For instance, a 'quiet hour'
with 'the books on Ayers Rock by Charles Mountford (1965) and Bill Harney
(1963) quickly fascinates the reader in the mythology of the rock'. Furthermore,
'many other myths associated with Uluru … help to bring this remarkable piece of
landscape to life'. This 'tourist experience' can be 'enhanced' all the way through the
journey, and build upon itself:

A group of tourists with their appetites for Aboriginal
mythology already whetted … will almost certainly derive added
enjoyment from a visit to Ayers Rock by having an Aboriginal
guide explain the basic mythology of the various features of the
rock.

The evocation of country as national heritage plays a further role in the
'nationing' of the Australian landscape. Even writing 'the Australian landscape' is
anomalous and anachronistic. Australian landscapes are neither homogeneous nor
ineffably Australian through time. They have only been nationally 'Australian' for a

64 Robert Edwards, ed., The Preservation of Australia's Aboriginal Heritage (Canberra: Australian
Institute of Aboriginal Studies, 1975), 1.
65 Ian Leggoe, 'Aboriginal involvement in central Australian tourism: An economist's viewpoint', in
66 Leggoe, 'Aboriginal involvement in … tourism', 84-5.
little over one hundred years. Their modern shapes are determined by up to two hundred years of European-style cultivation with an evolving Australian twist. Before and alongside the British settlers, as much as fifty thousand years of Aboriginal husbandry shaped different parts of the continent in different ways. Superimposed over and preceding the human influences are grander scales of climate and tectonically-induced changes. Indeed the continent itself may have taken on many different outlines in the last few hundred millennia, depending on the amount of water iced up at the poles, not to mention the intricacies of plate tectonics.

Deep time and geological heritage offer a complementary trans-national counterpoint to the 'national landscape'. Geoscientists are keen to emphasise international continuities and ties as much as national ones. But there is a double bind. To protect 'geologically significant' features and landscapes they often need to appeal to the so-called national interest. Hence the nation's geological heritage consists of an ill-defined, expanding catalogue of sites and features.

The human geographer Graeme Aplin, reflecting on the nature of heritage management in the late twentieth and early twenty-first centuries, declined to prescribe a definitive answer to the question he posed, 'What is "heritage"?'. Graeme Davison refused a simple answer to a similar question in The Use and Abuse of Australian History, published in 2000.67 It is not sufficient to come up with a broad, all-weather definition, because nothing about the word is definitive. Even a discussion of its plurality of meanings and origins cannot hope to satisfy everyone. Still it is worthwhile briefly to consider some antecedents and counterparts to the practice of geological heritage in Australia.

Chapter III

Managing the deep past

Heritage and geological heritage

In 1985 Isabel McBryde wrote in an introduction to a collection of essays about the control of cultural heritage that 'the site as national symbol' emerged in the nineteenth century 'as part of the historical self-consciousness of a number of European states'. Demands for guidelines for the protection of this national 'heritage' were 'couched in terms of the site as both symbol and patrimony'.\(^1\) The site or artefact physically and metaphysically linked the past with the present. States thereby re-invented both past and present to serve national and political agenda in the pursuit of 'collective self-conscious identity'.\(^2\)

Ten years later Denis Byrne connected the 'concept of heritage' inextricably to the practice of archaeology in Australia 'since at least the 1970s'. In keeping with McBryde's argument, he wrote that 'archaeology and cultural nationalism march hand in hand in virtually every country in the world'.\(^3\) Tim Bonyhady mused on the 'forgotten' pre-Federation antecedents of the 'preservationist usage' of heritage by the Whitlam Government, seven decades after Federation. He provided a contemporary legal definition of its bedmate, the National Estate, 'defined in the Australian Heritage Commission Act as those parts of the natural or cultural environment that "have aesthetic, historic, scientific, or social significance or other special value for future generations as well as for the present community"'.\(^4\)

This list of prerequisites foregrounds attributes considered important by people involved in the identification, interpretation and conservation of geological heritage, but it also highlights an important difference between the articulation of geological and mainstream heritage 'values'. The custodians of geological heritage such as the Geological Society of Australia (GSA) find particular resonance in references to 'scientific' value, 'other special value' and the allusion to posterity in

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\(^1\) McBryde, *Who Owns the Past?*, 2.
\(^3\) Byrne, 'Deep nation', 82.
\(^4\) *Australian Heritage Commission Act 1975 (Cth)*, s. 4(1), quoted in Tim Bonyhady, 'The stuff of heritage', in *Prehistory to Politics: John Mulvaney, the Humanities and the Public Intellectual*, eds
the phrase 'future generations'. They have traditionally regarded 'aesthetic'
significance, given precedence by the Australian Heritage Commission (AHC) Act,
as marginal.

However, the convenor of the GSA's standing committee on geological
heritage, Bernie Joyce, noted that in Australia 'Pioneering work on the assessment
of aesthetic values was carried out during the Central Highlands study', the second
AHC joint assessment of National Estate values, undertaken in conjunction with
the Victorian Department of Conservation and Natural Resources, in the early
1990s. Recently, the GSA has considered the ill-defined 'aesthetic values' as an
'avenue for further research', not to mention a possible inducement for financial
support and site protection. In the United Kingdom the RIGS ('Regionally
Important Geological/geomorphological Sites') programs consciously involve local
organisations and people with site protection and management, including the
assessment, promotion and maintenance of 'aesthetic character'. There is space
between the AHC criteria and the pragmatic, scientistic approach of the GSA to
harness geological heritage and notions of deep time to landscape aesthetics
thereby fostering in the general public a broader, geologically-informed
appreciation of both geology and landscape.

Explaining geological heritage
Geological heritage identification and management is an evolving method with a
body of literature often buried in reports and submissions by the various groups
associated with its articulation and implementation. The movement has to some
extent (reciprocally) adopted the rhetoric of UNESCO's World Heritage
Convention with its ranking of significance into local, regional, national and
international categories and the apparent contradiction of 'uniqueness' or

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6 E B Joyce, *Assessing the Significance of Geological Heritage: A Methodology Study for the
Australian Heritage Commission*, a report prepared for the Australian Heritage Commission by the
Standing Committee for Geological Heritage, GSA (Melbourne: Geological Society of Australia,
1995), 19: 'This aspect ['aesthetic value'] is listed as one of the avenues for further research
(Australian Heritage Commission 1994a, p.70')

6 M Harley, 'The RIGS (Regionally Important Geological/geomorphological Sites) challenge:
Involving local volunteers in conserving England's geological heritage', in *Geological and
Landscape Conservation*, eds D O'Halloran, C Green, M Harley, M Stanley and J Knill (London:

7 Joyce, *Assessing the Significance of Geological Heritage*, 4-5.
'outstanding value' tempered by 'representativeness'. Joyce described the approaches in the following terms:

In any assessment of significance, two approaches are used, whether consciously or unconsciously … the Representative and the Outstanding approach … A spectrum of importance … could be used … At its most outstanding or striking, a feature might be classed as unique … A further concept, that of rarity, has been used … At the rare end of the scale we may have a unique site. At the common end we may have a group of features, from which a representative example could be selected.8

He justified 'representation' as allowing 'a significance to be attached to one or several features which can best represent a group of similar features'. It 'need not be outstanding or striking, but need only be typical of the group it is to represent'.9 Other assessment criteria include educational potential, historical significance and importance for ongoing research or reference.

Geological heritage may be embodied in a 'site' or a 'feature'. A site is an area of land of geological interest, such as the Willandra Lakes World Heritage Area or the Hallett Cove Conservation Park (Plates 5 and 6). A feature shows an aspect of geology or geomorphology without necessarily having a particular 'extent': it may be a process such as erosion or a discrete site, exposure or object, like a type section or a fossil locality. For example, the park boundaries at Hallett Cove protect exposed objects like the ancient glacier-carved pavements of Tate's Rock and processes such as the badlands erosion of the nearby Amphitheatre (Plate 6). The Lake Callabonna and Lake Eyre basin fossil localities individually constitute features, although they can also be described as sites according to GSA guidelines.

The terminology, like much about geological heritage, reflecting the discipline from which it takes its name, is both specific and slippery. Earth scientists use the term 'geological monument' to embody things or areas of geological heritage significance, or, to quote Bernie Joyce again, 'those features of a region which form the essential basis of geological education, research and

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Geological heritage is patrimony of a different kind, ostensibly harnessed not in the interests of collective national identity but pragmatically as a scientific or educational resource. However, control of meaning is as important to the community of earth scientists as to other heritage practitioners.

Notwithstanding a shared vocabulary, shared legislation and some shared sites, geological heritage is distinct from other types of 'natural' and 'cultural' heritage, with different emphases. Landscapes embody it as earth history, revealed like the cyclical climate change evident in the Lake Mungo badlands stratigraphy; and as the history of a discipline in Australia, illustrated by certain landforms or material remains, for instance Tate's Rock or the site of the 1893 South Australian Museum campsite at Lake Callabonna.

So earth scientists value a geological monument for its physical qualities or for the stories it tells about the development of their discipline. The GSA terms the latter 'classic sites'. The distinction converges with Graeme Aplin's umbrella notion of heritage that, in an Australian context at least, 'Two sets of ideas – heritage as a set of ideals, and heritage as things – merged in the 1960s so that heritage now refers to things that represent ideals'. Geologically significant sites and their ongoing protection ensure the continuity and integrity of earth science research in Australia. The landforms – as receptacles in which scientists locate geological knowledge – keep the history and the future of the discipline.

The performance of geological heritage also differs from broad ideas of cultural and natural heritage because of its emphasis on practical research over

10 E B Joyce and R L King, Geological Features of the National Estate in Victoria: An Inventory Compiled for the Australian Heritage Commission (Melbourne: Geological Society of Australia [Victorian Division], 1980), 156.

11 See Aplin, Heritage, 1-2 and , J Thorsell, 'How natural are World Heritage natural sites?', World Heritage Newsletter 9, 1995, 8-11, for the argument that it is often not appropriate to divide heritage into separate 'natural' and 'cultural' realms. To this end, Sarah M Titchen ('On the construction of "outstanding universal value": Some comments on the implementation of the 1972 UNESCO World Heritage Convention', Conservation and Management of Archaeological Sites 1(4), 1996, 240) has indicated that a future challenge for the World Heritage Committee 'will be to ensure a seamless approach to heritage previously categorized and separated as being either natural or cultural, and to adopt an inclusive plurality in the identification and assessment'. It recently began this process with new legislation, reclassifying World Heritage sites such as Uluru, which formerly qualified under both natural and cultural criteria, as 'cultural landscapes'.


13 Aplin, Heritage, 15. Davison (The Use and Abuse of Australian History, 112) made the same point.
notions of patrimony. Barry Cooper and Maud McBriar, both past convenors of the
sub-committee on geological conservation of the South Australian branch of the
GSA, and Bernie Joyce have all stressed the importance and difficulty of finding a
balance between the incompatible requirements of conservation and of industry.
The GSA as a national body representing a membership drawn from among
Australian earth scientists in industry and academia is uniquely and tenuously
poised.

Often the short term needs of extractive sciences and earth heritage are in
conflict. Extraction is anathema to many National Parks representatives who share
the custodianship of geological monuments within national park boundaries.
Conversely in the eyes of many geologists the point of geological conservation is to
aid present and future geological research, which is sometimes necessarily
destructive. Some members of the GSA perceive a potential and irreconcilable
conflict of interest for the society between the requirements of the extractive
industries and the requirements of conservation. They anticipate that the protection
of sites and features on the grounds of geological significance will set a precedent
with awkward ramifications for the mining industry.14

Geological heritage and the counterfeit past
On the other hand, sites of geological heritage form part of the national estate. With
respect to cultural heritage, McBryde wrote that 'New visions of the past, or new
versions of the past, may serve social and political ends'.15 This applies equally to
natural and geological heritage. The site or feature becomes a symbol of national
unity. In a nation like Australia which has not reconciled its precolonial and
colonial pasts with its 'post'-colonial present, geological 'patrimony' is usefully
located in a prehuman past that can be made national and international.

Non-indigenous Australians, accused by cultural historians like Paul Carter
of co-opting landscape history and Aboriginal heritage into the business of building
a common national identity, as a sort of prosthetic past to compensate for our
shallow roots, can embrace the superlatives 'oldest', 'largest', 'outstanding', 'world-

14 Barry Cooper, pers. comm., 26 January 2000. See also Rosemary Swart, 'Environmental
protection of Geological Monuments in South Australia', unpublished Masters in Environmental
class', freed from the burden of someone else's history.16 Lake Callabonna 'represents a unique accumulation'. There is 'no other site like it in the world'.17 Hallett Cove achieves 'world-wide significance' because of its links to other Gondwanan sites across the globe.18

In a similar vein, Mike Archer, the former Director of the Australian Museum, delivered a public lecture recently at the National Museum of Australia on Australia's fossil 'firsts' – the oldest and the biggest.19 Researchers at the University of Sydney have lately revised size parameters for extinct Australian megafauna, radically and controversially, insisting chauvinistically that 'Australian students are spoon fed the notion that Australia could not support big mammals, and that's bollocks. Australian (megafauna) was not the runt of the litter'. Archer weighed in, declaring that the research 'disproved the theory that prehistoric Australia had underdeveloped wildlife', demonstrating that 'there's nothing deficient about Australia. It produced some of the most spectacular animals in the world'.20

This rhetoric, equating lack of size with deficiency, inadequacy and underdevelopment, locates national pride in characteristics of the material remains of a pre-national past. Another agenda that may be operating here stems from the perception that the museum-going public will find more romance and excitement in a three tonne Diprotodon than in a one tonne Diprotodon. It seems that for the purposes of attracting funding and public interest, it is advantageous to be old, gargantuan and dead.

In the context of the Ediacaran chordate discussed in the previous section, nationalism, South Australian parochialism and the idea of geological patrimony combine with extravagant language and scientific import to fuel media interest and imbue the 6cm-long tadpole-like lump with unwarranted significance for the

16 See, for example, Paul Carter, Living in a New Country: History, Travelling and Language (London: Faber, 1992), Introduction.
17 Wells and Tedford, 'Sthenurus … from the Pleistocene of Lake Callabonna', 3; Tedford, 'The Diprotodons of Lake Callabonna', 354.
18 South Australian Science Teachers Association (SASTA), 'The need for the Government to acquire and preserve an extensive area of land at Hallett Cove as Major District Open Space', unpublished report, 1971 (private collection of C W Bonython), 3.
19 He delivered the lecture on 22 August 2003 (Tom Griffiths, pers. comm., 10 December 2003).
forging of national pride. The *Age* reported the fossil's discovery on 23 October 2003, noting that it 'might represent more than just the earliest evidence of vertebrate life. It might also define an area of the Flinders Ranges, 490 km north of Adelaide, as one of the crucibles of life'. In a similarly excitable vein, Kerry O'Brien of the ABC's *7.30 Report* explained on 28 October that 'when it comes to the prehistory of the planet – which always has its fascination – the holy grail of palaeontology is to find the origin of life'. Later in the program, Tim Flannery, the Director of the South Australian Museum, declared that 'Australia has the oldest rocks on the planet, the oldest living things on the planet, the oldest animal fossils on the planet ... [the fossil] appears to represent the oldest chordate ever found, and that is the earliest member of our lineage. So it's really our earliest ancestor, found here in SA'. The item concluded with the reporter, Mike Sexton, explaining that 'palaeontologists believe a further legacy for Australians is to have a greater appreciation of what treasures lie in the outback'.

**Global and local pasts**

In this context archaeological patrimony is immediately problematic. Some archaeologists argue that the human remains like those from Lake Mungo transcend race and ownership because of their great age (upward of forty five thousand years), the impossibility of tracing modern affiliations or of gauging the wishes of the long dead, and their impact on debates about the origin and radiation of modern human beings: justification by globalisation. For example, John Mulvaney, an eminent Australian historian and archaeologist, has long been an impassioned advocate for the 'protection of cultural heritage as "a national possession" essential to collective self-perception'. But for Mulvaney, archaeology must be trans-

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21 For example, see Anon., 'Fossil find fuels museum road trip', *Advertiser* (Adelaide), 29 October 2003: Professor Rod Wells (Honorary Research Associate, Palaeontology, South Australian Museum) 'If you think about it you are digging into Australia's history ... What people don't realise is that South Australia is the richest state for fossils'.

22 Debelle, 'Fossil could be backbone of man's beginnings'; Mike Sexton, 'SA fossil could change evolution theories', *7.30 Report*, ABC, 28 October 2003. Transcript of interview. Note that despite Flannery's claim to the 'oldest rocks on the planet', a counter-claim has been made for metamorphic rocks of the Isua Supergroup in south west Greenland, which survive from around 3700 million years ago (Ma). Derek York similarly claimed Northern Canada as the locale for the world's oldest rocks in *In Search of Lost Time* (London: Institute of Physics Publications), 73.

23 Isabel McBryde, 'Past and present indivisible? Archaeology and society, archaeology in society', in Bonyhady and Griffiths [eds], *Prehistory to Politics*, 67.
national as well. As the British archaeologists Colin Renfrew and Paul Bahn expressed it, 'The world archaeology is something in which we can all share.'

Except for the canonical Mungo Man and Mungo Lady, workers refer to the other Willandra Lakes remains for the most part as the impersonal 'Willandra Lakes hominids', nomenclature which works to distance the burials from an emotive, personal, political, human present.

Conversely, some Indigenous Australians argue that the remains are the ancestors of the traditional owners of the region and therefore constitute Aboriginal cultural property and should be 'returned' to the Indigenous 'owners' for appropriate disposition. We may have no access to the wishes of the interred or their families, but the very fact of their interment implies attitudes to burial and an afterlife suggestive of a desire to stay buried. On the one hand is the assumption of the 'universality of [archaeological] values'. On the other are the unassailable moral claims of dispossessed people to what they perceive as their cultural property, and the assumption of a homogeneous community of Aboriginal meaning and culture through time.

These debates are of course not restricted to Australian archaeology. The predicament of many North American archaeologists is characterised by situations like the ongoing, often acrimonious debate surrounding the discovery, acquisition, investigation and disposition of the so-called 'Kennewick Man', found in 1996 in eastern Washington state. Among the most complete ancient skeletons excavated in North America, questions of its 'cultural and genetic affiliations' are balanced by questions about the nature of the truth claims of Western science versus those of indigenous traditions and the ownership of pre-Columbian material culture.


26 Debra Jopson, 'Lay ancient Mungos' bones to final rest, say custodians', Sydney Morning Herald, 31 May 1999.

27 McBryde, 'Past and present indivisible?', 66.

Philosophical issues attached to the notion of geological heritage are at first glance less thorny than those linked to the material remains of the human past. The questions of 'who owns the past?' – its physical remains – and 'who controls the past?' – perceptions of the past – seem to be less sensitive when dealing with 280 million year old glacial deposits at Hallett Cove or the fossil traces of Precambrian 'jellyfish' at Ediacara, as opposed to the remains of somebody's meal or great aunt in the human past. So geological heritage operates very differently at the archaeological sites of the Willandra Lakes compared to Hallett Cove and Lake Callabonna.

The issues become hazier – or at least, perhaps they should – when dealing with material that may have informed Aboriginal accounts of their own pasts. For instance, nineteenth-century naturalists and their informants reported many Aboriginal accounts which linked megafaunal bone yards such as the Callabonna site with ancestral figures and the formation of the land and its features. In the case of Tyrannosaurus Sue, local Sioux claimed that the fossil was a mineral resource akin to oil and therefore belonged to the Native Americans who controlled the reserve, in the same way that oil leases do. In 1996, fossil 'poachers' removed several 120 million year old, fifty-centimetre long theropod and stegosaur footprints from Crab Creek, near Broome in Western Australia, sending 'shockwaves' through the palaeontological community. According to local Aboriginal people, the dinosaur tracks belonged to the 'giant emu man'. A posting by Chris Nedin, a South Australian palaeontologist, to an online forum at the Chicago Field Museum of Natural History, noted that the local custodian, Joseph Roe, 'now fears spiritual retribution against him and/or his family' and that the thieves showed 'a callous disregard for the beliefs and customs of the local


29 A W Howitt and Otto Siebert, 'Two legends of the Lake Eyre Tribes', Report of the Ninth Meeting of the Australasian Association for the Advancement of Science, Hobart, 1902, 525-32; Gregory, The Dead Heart of Australia, 3-9.


31 Reynolds, 'Fossil thefts'.

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people'.  

32 John Long, a palaeontologist at the Melbourne Museum, formerly based at the Western Australian Museum, noted that the trackways were sacred to local Rubibi people, and formed part of the Lurujawi Heritage Trail. Local elders cursed the perpetrators. Is there such a thing as non-cultural heritage in country as saturated with human meaning as the Australian landscape?  

Protecting the deep past

The South Australian division of the GSA has played a central role in the preservation of geological heritage in that state since 1966 when the glacial pavements of Hallett Cove became the movement's flagship.  

From 1958-75 campaigners fought to prevent housing developers from building over coastal landforms and geological exposures with historical and educational significance. The society made the glacial landforms a geological monument in the 1960s and the fifty hectare park, opened in 1976, was placed on the Register for the National Estate in 1981. The perceived danger to Hallett Cove's geological 'integrity' posed by the proposed suburban developments mobilised academic geologists, teachers and those concerned more generally with lack of public consultation and the state's natural heritage.

Lake Callabonna made an easier transition to protected landscape, declared a 'fossil reserve' in 1901. But the protection offered by legislation did not extend to practice. The fossil site was largely ignored, presumed 'lost' by local landholders and the South Australian Museum, for some fifty years, until the intervention of the international face of science, in the person of Ruben Stirton, then at the University of California, Berkeley, who rediscovered the museum's original campsite and the 'necropolis' of Diprotodon bones there. Its relative obscurity and isolation may have been a blessing, protecting the site from the covetous eyes of developers (as at the conveniently-close-to-Adelaide Hallett Cove), poachers and rock hounds, and indeed from the intrusive excavation techniques of professional palaeontologists.


33 An account of the incident, and the long hunt to recover the trackways, appears in John Long, The Dinosaur Dealers (Sydney: Allen & Unwin, 2002). The theft was reported on the front page of the Australian on 16 October 1996.

Unappreciated by earth scientists until the 1960s, Lake Mungo and the rest of the Willandra Lakes entered the archaeological canon at the right moment for legislative protection. Gough Whitlam established the Hope Commission of Inquiry into the National Estate in 1972. By 1974, it was enshrined in the Australian Heritage Commission Act. Unappreciated by earth scientists until the 1960s, Lake Mungo and the rest of the Willandra Lakes entered the archaeological canon at the right moment for legislative protection. Gough Whitlam established the Hope Commission of Inquiry into the National Estate in 1972. By 1974, it was enshrined in the Australian Heritage Commission Act.35 Australia was an early signatory to UNESCO's World Heritage Convention which came into force late in 1975.36 By 1979 Albert and Venda Barnes, the lessees at Mungo Station, had retired to Mildura, leaving land over which they had held custody for 45 years, their children disinherited in favour of the new Lake Mungo National Park, preliminary to the inscription of the Willandra Lakes on the World Heritage list in 1981. The last of the three sites to receive formal protection for its ancient wonders is today a major tourist attraction, protected to the limit of conservation legislation as a national park, with World Heritage classification for its cultural and natural values, celebrated as an Australian Ararat, the site of the oldest human burial yet found in Australia.

**How to recognise heritage**

All this serves to suggest that 'deep time' endows a landscape with value, mystery and grandeur, especially in a continent apparently lacking in scenery which corresponds to western notions of the sublime or romantic. But a tract of land needs more than just a deep past to capture the public, bureaucratic and heritage imaginations. Recognition – the perception of significance – is paramount, which means that formal classification and appreciation are locked in an uncomfortable handshake. Landscapes are larger than themselves. The Naracoorte Caves World Heritage area provides a salient example (Plate 1).

The cultural Naracoorte Caves, in south eastern South Australia, is an environment in which palaeontologists actively unearth the deep past from caverns and fissures, 'rebuild' it in on-site laboratories, and package it for public consumption and comprehension in the artful and high-tech environment of the $1.75 million Wonambi Fossil Centre, opened by then Premier John Olsen and the State Environment Minister, Dorothy Kotz, on 4 December 1998.37 The

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'Pleistocene' landscape they contrive there is part of a long tradition of prehistoric dioramas, from De la Beche's scenes of ancient life in Dorset, published in 1830, to the well-stocked landscapes of 'Walking With Dinosaurs'. Its philosophical heritage includes the invocation of a catastrophic deluge to account for speleological jumbles of cryptic bones and sediment, and a long period of scientific obscurity when South Australia had no Geological Survey and prospectors were more interested in gold than palaeontological wealth. The nearby town of Penola was the heartland of Mary McKillop's order of teaching nuns and her mentor, Father Julian Tenison Woods, published the first, long-neglected account of the remains of extinct mammals found in 'Big Cave' in 1859.38

European settlers discovered Big Cave in 1845. Christmas Day picnics at the cave were inaugurated in the 1860s. On 12 February 1863, Naracoorte welcomed Governor Daly with a nineteen gun salute, 150 people 'and 52 natives performed a corroboree in the main chamber, which was lit by 300 candles', while 'a brass band hired for the occasion … enlivened proceedings'.39 Bat Cave was mined for guano as early as 1871. As part of a nascent 'tourist' industry, the spectacular stalactite-bedecked Blanche Cave (formerly Big Cave) was the site of Gala Balls in the 1880s. In 1885, the Woods and Forests Department appointed a caretaker, Daniel Battams, 'as a result of the popularity of the caves and their vulnerability to vandalism'. By 1908, nine caves were open to the public.40

In 1969, Grant Gartrell and Rod Wells discovered the magnificent 'fossil chamber' in Victoria Cave on an expedition by the Cave Exploration Group of South Australia. As well as its scientific potential, Wells recognised that the locality presented an unprecedented opportunity for scientific tourism. This was the germ of the idea of the Wonambi Fossil Centre. The fossil chamber was opened to the public on 20 December 1969.41

In 1972, control of the caves passed to the newly constituted National Parks

40 Murdoch and Parker, History of Naracoorte, 121; NPWS, South East Region, Naracoorte Caves Conservation Park Management Plan (Department of Environment and Planning, 1992), 4, 10.
41 NPWS, Naracoorte Caves … Management Plan, 11. See also R T Wells, 'Reconstructing the past: Excavation in fossil caves', Australian Natural History 18(6), 208-11.
and Wildlife Service of South Australia. Between 1974 and 1989, the caves saw an average of 55,000 visitors annually. As part of the (former) Environment and Heritage portfolio of the South Australian Government's Department for Environment, Heritage and Aboriginal Affairs, the park now earns its keep as one of '5 key parks' collectively attracting a total of 614,000 visitors in 1998-9.

In September 1993 at the World Heritage Committee meeting in Paris, the Naracoorte Caves were part of a serial nomination of sites known, ingeniously enough, as the 'Australian Fossil Mammal Sites'. The nomination also included Murgon and Riversleigh in Queensland. The three were said to represent 'the period of time since the Cretaceous that is largely unrepresented in existing World Heritage properties in other countries'. As a result of the nomination, Naracoorte and Riversleigh received a joint World Heritage listing in 1994, a degree of protection and lots of useful money. Murgon, the Trevor Chappell of the trio, received no listing, no publicity and no money with which to explore exciting new developments in Animatronics. Denied the opportunity of providing 'a revolutionary visitor experience' like Wonambi, the site returned to media obscurity.

Launching the Wonambi Fossil Centre in 1998, the then South Australian Minister for Environment and Heritage, Dorothy Kotz, described the park as 'one of the jewels in the State's national parks crown', suggesting it would 'provoke discussion about the past' – a world 'so very different, and yet so similar, to our own'. Wonambi provides elucidation of the Naracoorte fossils' 'most eloquent form of poetry from the past; a poetry of death and of survival'. Yet without its World

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45 Dorothy Kotz, quoted in Anon., 'Naracoorte welcomes you to Wonambi Fossil Centre'.
46 Note that Murgon's bid was rejected because of 'major concerns' regarding the legitimacy of the dates, a point which workers at the site used to argue for more funding for re-dating. Despite the doubts, the site has not been re-dated, but '55 million' has captured the public imagination, thanks in part to the media savvy of the site's most high-profile advocates (Rod Wells, email, 5 February 2004; IUCN, 1994, Advisory body evaluation 698: Australian Fossil Mammals, UNESCO, Paris).
47 Dorothy Kotz, quoted in Anon., 'Naracoorte welcomes you to Wonambi Fossil Centre'.
Heritage funding and publicity, Naracoorte, too, could be a mere speleological footnote, the abode of bats with a snake in every corner, rather than 'a site of true world significance, from a scientific perspective', notwithstanding its prominence as the type locality for several species of bat guano-dwelling arthropod.\textsuperscript{48} Meaning is not intrinsic. It is established not by geology, climate or biota but the cargo of memory and representation that distinguishes them.

The entangled country

I have concentrated on groups of stories that foreground continuities across the three landscapes that constitute the major foci of this thesis. Each case study consists of many tightly braided threads, the intersections of lives, texts and landscape, and of popular and learned, sacred and secular ways of knowing: Landscapes, sense of place and geological knowledge are mutually constituted.

The first major thread of the Hallett Cove study of Part Two involves stories of Ice Age Australia, shifting down in scale to the local landscape histories and the late onset of aridity which comprise the second thread. The third thread includes the stories of glaciology and of public geology in Australia, focusing first on a disciplinary history since the 1870s and then on the campaign by geologists to engage public interest in the fate of the Hallett Cove glacial pavements in the 1960s. South Australian geologists regard the landforms of the Hallett Cove Conservation Park as scientific cultural artefacts in equal measure with their status as geological relics and records in an 'outdoor laboratory'. The park is a living cultural landscape. The social, intellectual and environmental histories of the conservation battles of the 1960s and 70s overlie the histories of nineteenth-century glaciology and distribution studies, which in turn overlie (and are interleaved with) the history of the shape of the land.

There are also three main strands to the Lake Callabonna weave in Part Three. The first concerns the stories of inland aridity. The second concerns the stories of the extinct Pleistocene megafauna and their material remains. The third is a story about vertebrate palaeontology in Australia. One element of this latter strand – the story of the rejuvenation of the discipline in Australia during the latter half of last century – roughly parallels the third thread of the Hallett Cove story – the mobilisation of public geology in South Australia during the battle to preserve the Hallett Cove landforms from destruction a decade later.

Lake Callabonna, though provided with a degree of protection from destruction or exploitation as a 'Fossil Reserve' similar to Hallett Cove's 'conservation park', is not regarded as a cultural landscape in the same way as the cove or the Willandra Lakes landscapes. Indeed, palaeontologists and pastoralists alike tend not to regard it as a landscape at all, so much as a repository and an impediment. But at the same time, the window onto a 'lost world' provided by the
material remains of its deep past imbues the physical landscape with a certain cachet and mystique, and an unassailable place in the psyches of Australian vertebrate palaeontologists. Likewise, stories associated with the site provide some of the foundational myths of the discipline. Lake Callabonna does not need to be visited or inhabited to be a cultural landscape.

Finally, the Willandra Lakes provide three strands: first, stories of aridity and the watered inland; second, the stories of bones and peoples – fossil bones, Aboriginal people, pastoralists and academics; third, stories of material culture and archaeology. Once again, the third thread, involving the debate over repatriation of human remains, centres on a battle for the shape and control of meaning, between so-called public, intellectual and indigenous interests. The Lake Mungo National Park is a museum recording thousands of years of human-climate-landscape interactions, from the *unio* shell and fishbone middens, hearths, grinding stones and graves of its Aboriginal owners, to the relics of European pastoralism and the soldier-settlers of the mid-twentieth century, to the ongoing signs of human management in the cultural resource centre located on the lake's margin. This coincidence of cultural and environmental indicators is at the core of the lakes' scientific and heritage importance.

As a national park within a World Heritage area, the Willandra Lakes region and especially Lake Mungo are multiply contested sites of Aboriginal-pastoral, Aboriginal-archaeological and archaeological-pastoral interactions. Much of the World Heritage area is still farmed, but lessees must control the numbers and access of sheep and cattle strictly. The burial sites of Mungo Lady and Mungo Man hold particular significance for contemporary Indigenous people in the area. The lakes provide a 'living' geomorphic laboratory, revealing mechanisms of the terminal Pleistocene and Holocene.

The stories connect in the material landscapes and in the deep past. So notions of geological heritage provide a thread of continuity across the three case studies, but this means different things at different sites. At Adelaide's Hallett Cove, earth scientists are concerned to preserve 'geology-in-action'. The landforms and the processes that shape them are all-important. The landscape itself embodies part of the nation's geological heritage.

In contrast, at Lake Callabonna in South Australia's arid northeast, palaeontologists are less concerned with preserving the landsurface and evidence of
the processes that affect it, so much as the fossils buried within. It is a highly mobile landscape in any case, of shifting sands and mud and sporadic floods. Palaeoclimatic reconstruction there has predominantly involved retrieving data from the sediments, in the shape of bones, pollen and dirt, and removing them to a laboratory in Adelaide. The most efficient way of finding vertebrate fossils in such landscapes involves shifting huge amounts of overburden quickly, with excavators.

The Willandra Lakes World Heritage area falls somewhere in between the other two. Archaeology is a necessarily extractive science, like vertebrate palaeontology. Its practitioners need to dig and 'rescue'. But the region contains valuable *in situ* sites as well, both cultural and geomorphological, preserving evidence of landscape and climate change. Furthermore, erosion plays an equivocal role as it both destroys and reveals the material remains of the past.

Continuities between sites are inescapable. It is a scientific truism that the modern shape of Australia is a reflection of Quaternary processes and underlying geology. 'Australia' during much of the Tertiary Period was warmer and wetter than it is today. There was little or no polar ice-cap in Antarctica. As subsidence continued in central Australia and the Lake Eyre basin, uplift along the Great Divide and the southern margin of the basin led to renewed sedimentation. The retreat of the same Late Miocene-Pliocene sea that covered Hallett Cove's glacial pavements left relict shorelines throughout southwestern New South Wales, western Victoria and southeastern South Australia. In these ridges formed the Naracoorte Caves karst system in South Australia. In New South Wales, they could have shaped the distribution of the Willandra Lakes.

Uplift of the Mount Lofty Ranges during the Pliocene provided a new source of sediment for the Adelaide Plains. With the onset of northern hemisphere glaciation during the Quaternary Period, sea levels fluctuated with the growth and decline of polar ice caps, alternately covering and exposing coastal plains of Spencer Gulf, Bass Strait and the Great Australian Bight. At the same time, lake levels in the interior fluctuated according to the balance and distribution of precipitation and evaporation and the amount of spring run-off. Cycles of erosion, glaciation and aridity, sedimentation and marine or lake incursion, groundwater effects, run-off and humidity, their legacies visible in landforms and stratigraphy, have combined over the last 500,000 years to produce the living, unfinished 'panoramas' of Hallett Cove, Lake Callabonna and Lake Mungo.
Cultural continuities also weave across the panoramas. The differentiation and professionalisation of the geosciences in the nineteenth century paralleled the backward extension of earth history in the Western scientific canon. All three – geology, archaeology and palaeontology – are historical sciences, grounded in the reconstruction of present and past landscapes, past events and past ecologies. So running through all three case studies is a potted history of the development of various branches of the earth sciences in Britain, Europe and the influence of Australian material during the nineteenth century, united in the emergence of 'distribution studies', or palaeo-biogeography as a sub-discipline of the geosciences.

Glacial studies refreshed geological and geomorphological hypotheses in the 1840s. The theory that much of Europe had been covered by glaciers at some time in the past rejuvenated the study of the distribution of living species and the mystery of the presence in the fossil record of giant extinct mammals, or the apparent fossil co-existence of cold-climate and tropical animals in regions where both became locally extinct. In the 1850s convincing evidence of the co-existence of primitive human beings again took the debate in a new direction and changed the focus to human antiquity. Perhaps ancient human hunters rather than extreme cold were responsible for faunal extinction.

Nineteenth-century savants like Charles Lyell (The Geological Evidences of the Antiquity of Man [1863 and 1873]) and James Geikie (The Great Ice Age[1877]) connected these three strands – the climatic, the biotic and the cultural – to speculate further on the modern distribution of plants and animals.¹ The modern debate about the extinction of megafauna rehearses some of these same factors, united in the geological and intellectual histories of Hallett Cove, Lake Callabonna and Lake Mungo, of climatic change, extinction and human exploitation of environments through time.

The inland sea is a common intellectual thread, both the predicted sea of western New South Wales and central Australia that never eventuated for the inland explorers, and the historical sea that geological orthodoxy suggests covered

parts of central and southern Australia during the Miocene and earlier. The inland
explorers read and misread signs of this sea in the shape of the land, in its shroud of
dirt and salt, its ripple-like dunefields and its fossil productions.

Geological heritage resists simple definition. Indeed, part of its value to this
study rests in its flexibility. Although earth scientists might prefer to divorce
geological heritage from 'non-scientific' agenda like tourism, politics and
nationalism, this has not proved easy. The preservation of landscapes on the basis
of their geological significance alone is sometimes not enough. As George Seddon
observed:

[Geologists'] skills of observation … are valuable beyond their
utility. They assist in building a broad understanding of place, so
much so that I can hardly conceive the image in Australia of
someone who does not automatically think of the Lachlan Fold
Belt when driving around, say, Yass; or when in northwest
Victoria, of the Murravian Gulf and its salt beds, or in the
Kimberley, of Devonian coral reefs. I value such information of
the geological past, not so much as information, but as a basis
for a more comprehensive interpretation and understanding of
the present, especially in acquiring a sense of place, which is
basic to all sound environmental planning and important to us
individually as a part of feeling at home in an environment. If
we as a society value such understanding, we must see that it is
accessible, both socially and physically, the former through the
school curriculum, the latter through safeguarding outcrops.

Not just critically important sections, either. Outcrops can have
aesthetic and historic, as well as scientific value.²

The Hallett Cove campaigners found it necessary to harness archaeology,
social history, botany, entomology, the history of science, notions of egalitarianism,
government corruption and non-consultation to ensure the preservation of some of
the cove's geologically important features. The success of the Willandra Lakes
World Heritage nomination can be linked to patrimony, landscape aesthetics and

cultural heritage as well as to scientific appreciation for the archaeology and
geology of the region. Lake Callabonna's geological significance has long been tied
to South Australian parochialism and institutional rivalry, although the Stirton
expeditions appear to have been rather successful exercises in cross-institutional
and international cooperation.

The material landscape (including fossils and features) as a repository of
knowledge about the past is a national resource, inseparable from ideas about
patrimony. It should be possible to embrace the aesthetics agenda of heritage
rhetoric and the monumentalism of the deep past to create the space in which new
notions of geological heritage and landscape aesthetics begin to be articulated.
PLATE 1. Locality map.

PLATE 2. 'The Geological Time Scale'.

This plate and Plates 3 and 4 are different pictorial representations of 'time', 'history' and the 'fossil/geological record'. They facilitate the naturalisation of scientific models of earth history, which is often conceived in terms of a linear, deterministic, fixed and natural sequence.


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<td>Earth's crust forms</td>
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PLATE 3. 'The Geologic Time Scale for the last 600 million years shows when different kinds of plants and animals lived'.

PLATE 4. 'Man Makes History'.

PLATE 5. The Lake Mulurulu lunette, Willandra Lakes World Heritage Area.

The lakes region is considered a 'site' for heritage purposes, while the lunette is both 'site' and 'feature' (photo K Douglas).

1. Panoramic view from the northern end with the Amphitheatre and Sugarloaf in the background (photo E M McBriar).

2. View of the Amphitheatre from the south. Note wooden walkways and the Sugarloaf in the centre (photo K Douglas).
Part Two

'Like a precious cameo': Hallett Cove, geological heritage and the glaciological imagination

The saga relating the ebb and flow of fortunes on this matter is very complex.

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Prelude

Treading on 'classic ground'

Hallett Cove is no parvenu in the aristocracy of heritage. Its service to debates about deep time is part of its birthright as a longstanding site of scientific interest. From early in its scientific story, the area has been celebrated for its geological legacy. By the 1890s, 'Tate's Rock', a glacier-carved pavement atop Black Point (now Black Cliff), was cited as a 'classic site' for the study of South Australian geology and the cove was a site of 'world' importance. However, concerted calls for its protection from housing developments and quarrying were not made until the late 1950s. Ironically, this was due to an assumption on the part of geologists and educators that the educational and heritage values of the site were inherent and self-evident and to a concurrent failure to keep abreast of altered zoning regulations rather than to any scientific neglect or devaluation of the cove, which had retained its emblematic status for South Australian earth scientists across seven decades of controversy and investigation.

Geological heritage is a many-headed beast. Its multiple possibilities emerge from the stories of Hallett Cove, read in each other and in the landscape: geological heritage as earth history revealed through the cove itself, and geological heritage as the

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2 For example: 'The point of greatest interest raised on this classic ground was the period at which this age of ice occurred' (Anon., 'Report of a field trip to Hallett's Cove during the fifth meeting of the Australasian Association for the Advancement of Science', Adelaide Observer, 7 October 1893, 43); 'the interest with which this locality has come to be regarded by the geological world has rapidly increased, and Hallett's Cove must now be ranked as classic ground in Australian geology' (W Howchin, 'New facts bearing on the glacial features of Hallett's Cove', Transactions of the Royal Society of South Australia, 19, 1895, 61).


4 Consider, for example, the debate between Ralph Segnit of the Geological Survey of South Australia, and Douglas Mawson and Reg Sprigg, of the Geology Department of the University of Adelaide, as to the age and nature of the glaciation at Hallett Cove, communicated in the pages of the Transactions of the Royal Society of South Australia in 1940 and 1942. See also W Howchin, 'Further discoveries of Permo-carboniferous glacial features near Hallett's Cove', Transactions of the Royal Society of South Australia, 48, 1924, 297: 'The remarkable features that distinguish Hallett's Cove as one of the most picturesque and interesting localities on the coast have long concentrated attention on the broken ground of the amphitheatere and the historic polished surface of purple slate discovered by the late Professor
history of the discipline in South Australia embodied in certain of its landforms. On yet another level, the events of the 1960s and 1970s, which resulted in some of the land at the cove being reserved as a Conservation Park, saw the interlacing of a third layer of significance. The fight for Hallett Cove became a test-case for the geological heritage movement in South Australia and its 'rescued' landforms, flotsam on a suburban sea, now hold the history of that battle as well.

**Hallett Cove since 1836**

The title of Part Two – 'Like a precious cameo' – comes from a National Parks and Wildlife Service (NPWS) brochure celebrating Hallett Cove. But the Hallett Cove landscape is, in most senses, not a 'cameo'. It exists in four dimensions. Each part of the land surface at any moment can be any part of its history. Picture it last summer. A sandy beach is punctuated with pebbles, stones and boulders. Low dunes on the foreshore are covered with green and yellow grass. Khaki scrub climbs to the cliffs and salt-whipped trees cluster on the clifftop. Behind the dunes, speckled concrete foundations in the dun dirt are the legacy of beach huts, torn down in the 1970s. The ground is black, brown, mottled, striped with pink and white and red.

Now imagine its likeness during the late Carboniferous or early Permian Period. Ice envelops all but the crowns of black bare mountains. A blue-white iceberg calves with a thunderous tear and splash from cliffs of ice on the edge of the sea or a glacial lake to the south east. As it melts, grit and boulders frozen into it fall through the water to lodge in the sediment below. 'Southern Australia' is covered by a continental ice sheet and the scene may be comparable with the Eastern Antarctic mountains of today.

Return to last January. Holdfast Bay is a soup of hopeful surfers, kelp, ecstatic poodles, assorted invertebrates, fish, children, seagulls and a ketch or two. The sun sears, but huge, scratched and polished boulders embedded in the beach sands recall the melting icebergs. Textures to taste and hear and the smell of decay verify the eyes' testimony that perhaps things in this somewhat overdetermined place have changed during the upper seventeenth of earth history. This type of juxtaposition is intellectual

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5 National Parks and Wildlife Service (NPWS), 'Hallett Cove Conservation Park and the Sandison Reserve', NPWS brochure, nd, 1.

sustenance for scientists of the deep past who draw shallow seas from deserts, glaciers from forests and mountains from lines in the ground.

Part Two begins with an outline of Hallett Cove's post-European history. A brief geology lesson follows, four interpretations of the earth history of Hallett Cove. Then a summary of some nineteenth-century scientific attitudes which informed the development of the science of glaciology serves as introduction to some of the protagonists in the saga of Hallett Cove and glaciation. I have emphasised their positions in relation to the ruling discourses of contemporary natural science. Finally, I move on to an account of the battle to 'save' the cove in the 1960s and 70s and the impetus this gave the geological heritage movement in South Australia.

The three chapters in Part Two will thus shed some light on questions that encompass the major themes of this work:

- What do the stories of Hallett Cove tell about the way the earth sciences are made?
- What contribution has the cove made to debates in Australia about deep time and geological heritage?
- In the context of Hallett Cove, how have national identity, regionalism and intellectual rivalry inflected the terms of reference for these questions?

Location and description

The Hallett Cove Conservation Park comprises 50.48 hectares on the eastern side of Gulf St Vincent, about twenty kilometres south of the city of Adelaide, in the Hundred of Noarlunga. It is partly bounded to the south by the 3.93 hectare Sandison Reserve and partly by the low-water mark along the beach at Hallett Cove. The remainder of the park and the reserve are bordered by residential development which makes the site unusual in South Australia's extensive system of metropolitan conservation parks. No visible boundaries separate the park from the Sandison Reserve, but a plaque marks the spot where the reserve was dedicated to the National Trust of South Australia in 1960. The trust still owns the reserve and the park is managed by the South Australian National Parks and Wildlife Service. The reserve was opened to the public in 1965 and the present boundaries of the park were dedicated a decade later (Plate 7).

The area was acquired primarily to protect vulnerable geological, archaeological, botanical and historical features which would otherwise have been destroyed during urban expansion in the 1960s. These include the 'internationally recognised' glacial pavements and erratic boulders identified in the 1870s and 'unique' geology which bears 'witness to six geological periods, each differing in climate due to
Australia’s changing position on the Earth’s surface’.7

From the time of the scientific discovery of the cove in 1877, this refrain of uniqueness, international renown and significance has been regularly replayed by naturalists, geologists, botanists, archaeologists, entomologists, journalists, residents, activists, conservationists and heritage bodies. Almost a century later an advertisement on behalf of the Save Hallett Cove Committee in September 1971 exhorted readers to ‘Save Hallett Cove’ as the ‘World famous geological treasures of this unique cove are threatened!’ Stuart Cockburn, a strong advocate for preservation of the cove’s geological wealth and a reporter with the main Adelaide newspaper, the Advertiser, explained that ‘Hallett Cove has, of course, long been known throughout Australia and overseas as a geological treasure house’.8

A field guide to Hallett Cove, published by the South Australian Museum in 1970, reiterated that the ‘unique locality, acknowledged by experts to be the best of its kind, is visited by scientists from all over the world’. The South Australian Science Teachers’ Association (SASTA) wrote in 1971 that ‘Hallett Cove is unique … Because of its Permian glacial deposits the region has world-wide significance’, restating later that ‘It is unique. It is of world renown’. The South Australian Town and Country Planning Association described the cove as ‘one of South Australia’s most valuable resources of this type – a unique landscape unveiled by erosion to give almost unbelievable glimpses of the past’. The same authors explained in the Sunday Mail that ‘overseas geologists visit the area because of its uniqueness and international importance as a link in the theory of continental drift’ and the ‘glacial areas are quoted in many overseas texts’. The Friends of Hallett Cove, along with members of the South Australian Museum and the University of Adelaide Geology Department provided guided tours during the 1960s and 70s, provoking such superlatives as ‘unique features’ and ‘world famous’ from Sunday Mail reporters.9


8 R Alcock, ‘Save Hallett Cove!’, Advertisement calling for public support, on behalf of the Save Hallett Cove Committee, Advertiser (Adelaide), 22 September 1971; S Cockburn, ‘Blood is up at the cove’, Advertiser (Adelaide), 15 September 1971, 2.

A much later field guide to Hallett Cove, published in 1999 by the Field Geology Club of South Australia in the spirit of the museum's 1970 edition, claimed that 'The Cove is recognised world-wide for being one of the most important and visibly interesting records' of the Permian Ice Age. Similarly in 2001 the National Trust of South Australia's journal, *Heritage Living*, described the area as 'a Mecca for geologists and naturalists since 1877'. But Ralph Tate's last word on the matter at the fifth meeting for the Australasian Association for the Advancement of Science, held eleven decades ago in Adelaide in 1893, still encapsulates the celebratory nature of South Australian geologists' reactions to Hallett Cove: 'Hallett's Cove remains unique in respect of the magnitude and completeness of the glacial features which are there preserved … we may congratulate ourselves'.

The park consists of low hills above variably rugged coastal cliffs, a grassy foreshore area near the southern boundary, an extensive rocky shore platform and sandy cove area, with deeply eroded gullies, together with westward-trending watercourses. Much of the native vegetation was cleared during the late nineteenth and early twentieth centuries and is retained in dwarfed form only in pockets of the less-accessible steep areas and in the gullies, although extensive re-planting of locally indigenous flora has proceeded in recent years. Large boulders, often as big as cars, lie on the beach (Plate 11).

*European discovery and settlement*

Hallett Cove's colourful municipal history has left a residue of names, remembered events and 'heritage sites' that invest the landscapes with local meaning beyond the essentially scientific and aesthetic significance of the Conservation Park. The cove itself was named for John Hallett, a prominent South Australian pastoralist and early Parliamentarian, who reportedly first saw the feature in 1837 while searching for missing stock. Hallett arrived in the new colony on the *Africaine* in 1836, aged 32. Land Grant records show the first sale of land to him on March 14, 1840. Alfred

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11 H M Cooper, 'An archaeological camp-site in the vicinity of Hallett Cove, South Australia', *Records of the South Australian Museum* 15, 1968, 625; [Toteff], *Hallett Cove Conservation Park*, 3, 66.
Hallett, his brother, joined him in 1841.\textsuperscript{12}

John Hallett gave evidence at a court held at Kingscote, Kangaroo Island, in the late 1830s, that the cove witnessed smuggling as, to escape excise, traders put spirits and other goods ashore there and at Brighton at night by boat from Kangaroo Island, then took them north to Adelaide by bullock dray.\textsuperscript{13} In the 1840s, silver and lead were found at Glen Osmond. Copper was found at Kapunda and then in 1845, following its discovery by a shepherd 150 kilometres north of Adelaide, the Burra Burra Copper Mine was established and for over a decade remained the largest mine in southern Australia, saving South Australia from bankruptcy.\textsuperscript{14}

Prospecting was carried out on behalf of investors anxious to partake of the colony's new mineral wealth. In 1847, prospectors discovered copper ore at Worthing Farm, a property owned by the Hallett brothers, in the valley of the Field River, 800 metres southeast of Hallett Cove proper.\textsuperscript{15} Samples sent to London were deemed promising and the Worthing Mining Company was incorporated on 2 July 1849.\textsuperscript{16} The venture remained something of a family affair: ten men, including two Halletts, each contributed £1000 to purchase the land from Alfred and John, who retained a considerable vendor interest. Alfred managed the mine.\textsuperscript{17} The company appointed a colonial committee which included John Hallett and the directors in England included several other Halletts.

Mining operations commenced in 1849 when Captain John Richards and a team of five working miners arrived from Cornwall to sink the first shaft. A steam engine, boiler and other machinery arrived from England late in the year and the team erected the engine early in 1850. The surviving enginehouse is unusual and may be the


\textsuperscript{14} South Australian Museum display 'Minerals and Meteorites', March 2001.


\textsuperscript{17} Evans, et al, 'Worthing Mine and environs', 4.
only one of its kind extant in the world.\textsuperscript{18}

During the 1850s, a community of about one hundred people rapidly became dependent on the mine. This community consisted of a blacksmith's shop, along with ten miners' cottages, a powder magazine storehouse and offices and a large manager's house, inhabited for a while by Alfred Hallett and his family. By 1855 the settlement supported a schoolmistress, Louise Waite. The company sunk three shafts half a mile apart, but the mine was never very successful.\textsuperscript{19} Contributing factors included low grade ore and the hardness of the ground which made digging shafts more difficult than anticipated. The mine's proximity to the Field River and the sea made it vulnerable to underground water, which poured in from fissures at 156 feet, the depth of the main shaft. These agents were abetted by the exodus of miners to the lucrative Victorian goldfields in 1852 which precipitated a chronic labour shortage and inflated wages for several years.

Notwithstanding its importance to the small community, the Worthing Mine closed in 1857, in serious financial trouble, when the company purchased the Bremer Mine at Callington, which Alfred Hallett also managed. By 1861, the cottages were described as 'dilapidated' and continued in increasingly derelict state until demolished over a century later. Some of the miners purchased land from the company and set up small farms. Alfred Hallett died in 1877, the year Ralph Tate announced the discovery of glacial features at Hallett Cove.\textsuperscript{20}

The 'Worthing or Hallett Mine, Enginehouse and Chimney and Environs' were nominated to the South Australian Register of State Heritage Items in September 1978 and registered on 24 July 1980. The site is National Trust classified. Although the mine never contributed significantly to South Australia's economy, its structures include the oldest surviving enginehouse and associated stack in Australia. It is a relic of the 'earliest period of base-metal mining in Australia' and 'lends itself to interpretation' as the most intact disused mine within metropolitan Adelaide. In its 'dramatic' location, in an artificially cleared landscape, the site 'has high potential for


\textsuperscript{19} Colwell, \textit{The History of the Noarlunga District}, 25; Dolling, \textit{The History of Marion on the Sturt}, 260; Evans, et al, 'Worthing Mine and environs', 4.

archaeological investigation'.

In a South Australian Museum publication of 1970, anthropologist Harold Cooper informed his readers that in the late 1880s, a mock battle was enacted near the southern end of the cove, between a landing party from the South Australian Government Navy cruiser, HMCS Protector, and a shore party. The first subdivision inland of Hallett Cove was laid out in June 1913 and known as Hallett's Cove Estate. In August 1914 another subdivision was laid out at Hallett's Cove Proper and the Hallett's Cove Model Estate was laid out in November of that year.

These events, trivial or momentous depending on individual or collective experience, actively shape meaning at Hallett Cove as surely as the abrasion of glaciers, the swelling of mountains, the tearing of continents and the curiosity and ambition of scientific men. And the success of the 'Save Hallett Cove' campaign of the 1960s and 1970s was as dependent upon the actions, experiences and dedication of communities, garage operators, mothers of four, schoolchildren and the scientifically illiterate as it was upon any meaning or value inherent in the rocks and sediments of cove landscapes as deciphered by the geological community. Experience shapes interpretation.

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23 Land Titles Office of South Australia, Land Services History Book.
Chapter IV

Interpreting change in the landscape at Hallett Cove

The story of Tjilbruke: Human agency and late Quaternary ecological change in Holdfast Bay

There are several sites within the Hallett Cove Conservation Park which indicate that Aboriginal people locally produced tools from the abundant stones which are a component of the cove's glacial legacy. Discovered by Harold Cooper in 1934, his colleague at the South Australian Museum Norman Tindale examined the area in the late thirties. Between the 1934 and his death in 1971, Cooper studied the site extensively. He tied it into Tindale's scheme of dual waves of Aboriginal settlement in South Australia. He believed that he had recorded evidence from both cultures at the site. He correlated the first 'wave' with Tindale's ancient Kartans, named for Kangaroo Island, at about 40,000 years ago when the present Gulf St Vincent was probably a coastal plain. The second 'wave', designated 'Murundian' by Tindale, may have settled the area around 6-8000 years ago. These people may be coterminous with the modern Kaurna people of the Adelaide Plains.1

There are problems with interpretation. The site, protected by the Conservation Park's boundaries and managed by National Parks, has not been revised in recent years in the light of advances in dating techniques, as there is not a lot of reliably datable material.2 But however the site is construed and constructed by archaeologists, the area was certainly inhabited by adaptive, creative people who, experiencing and deciphering the landscape, left more than just a material legacy.

There is a monument to Tjilbruke and the Kaurna people on a cliff above the Kingston Caravan Park north of Hallett Cove. Tindale transcribed the story that

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2 Mike Smith, pers. comm., 15 May 2000.
accompanies the monument, reportedly told him by an Aboriginal man of Lake Alexandrina. It describes the formation of springs and rock pools along the coast, including Waterfall Creek at Hallett Cove and goes something like this: Tjilbruke was the uncle of Kulultuwi. One day he heard that his sister's son had been killed at the place now known as Sturt Creek. The boy was struck down for breaking a tradition forbidding him to kill emus. His body had been taken to a place near Brighton to be smoked and dried.

Tjilbruke took the body of his nephew back to a spring on the beach at Marino (the spring on the Kingston Park foreshore below the monument). Having completed the smoking process, he carried his nephew along the coast to the place now called Waterfall Creek, at Hallett Cove, where he rested. As he thought about his nephew he started crying and a spring of water welled up where the tears fell.

He then journeyed to Port Noarlunga, where he burst into tears once more. He cried at Red Ochre Cove and yet another spring formed. Then he walked a few hundred yards south of the present Port Willunga jetty. The tide was out. His tears dropped on the sand and another spring appeared. At high tide the sea covers it, but to this day fresh water can be obtained by scratching in the sand.

Tjilbruke carried his nephew to the beach at Sellick's Hill where he noticed a fine bay suitable for catching sea-salmon at night time. His tears became a spring there too. He continued along the coast and wherever he stopped, more springs were created from his tears. Finally he returned northwards along the foreshore. He left Kulutuwi's body on a suitable ledge and transformed himself into a bird, similar to an ibis, and spent the rest of his days catching fish in a lagoon.

This interpretation describes the formation of some of the most modern of the relict features of the Adelaide area – streams and springs which come off the Mount Lofty Ranges and dissect the Plains. It is a very localised, intimate and personalised landscape history, at odds with the grand sweep of Ralph Tate's 'Retrospective Glance' of 1879, which now follows.

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4 This is a summary of words on the Kingston clifftop memorial plaque and a version of the story which appears in [Toteff], *Hallett Cove Conservation Park*, 9-10.
'A great change has come over the surface': A nineteenth-century Darwinist's view of glaciation at the cove

During the Pliocene period the land was much elevated, probably into regions of perpetual snow. The continent was then obviously vastly more extensive than now. Tasmania and New Guinea would then be united to the continent, as is required by the community of species of certain plants and animals. It was during this time that the large mammals roamed over the land, and the wide expanse of country allowed of the development of its peculiar and extensive fauna. The climate [was] moister, and the temperature of lowlands more equable than now, and generally the conditions were more favourable to the growth of succulent herbage capable of sustaining a large and varied mammalian fauna … This period was brought to a close by the lowering of the land … and in consequence of which its glaciers retreated … and the fertile tracts of the lowlands were submerged, and the productive powers of other areas diminished by the gradual desiccation going on. In this way the animals would be crowded on limited areas, and a struggle for existence would ensue, in which the less adapted and less easily modifiable would succumb … the larger animals would probably be the first victims, because of their slow breeding powers and of insufficiency of food within easy reach. The clumsy Diprotodon would soon be worsted in the struggle, while the fleeter Kangaroos could continue to hold their own for a longer period; and the extinction of the Thylacoleos would be involved in that of its prey.

Comparing the climatic conditions of the Pleocine [sic] Period – distant, but geologically recent, with those of the Present Period – we cannot doubt that a great change has come over the surface of South Australia in the decreased amount of water in the lakes or running in the rivers, in the increase of its mean annual temperature, and in the depauperization of its mammalian and
Tate delivered this paper in 1879, as part of the annual address of the President to the Philosophical Society of Adelaide, later the Royal Society of South Australia. His arrival in South Australia three years earlier had seen a rejuvenation of the society. He also inaugurated an annual series of public lectures and it was during the first year of these, in 1877, that he introduced past glaciation at Hallett Cove to the public and the academy. The 1879 address above drew in part on this 1877 lecture.

His depiction of change in the South Australian landscape was informed by his opinion that, in a geological timescale of unknown extent, the glacigene features at Hallett Cove and inland were of relatively recent origin, contemporaneous with the 'Great Ice Age' of the northern hemisphere. He reasoned this largely due to their startlingly fresh appearance. He was convinced that depletion of the faunal record was the result of climate change, from humid, 'equable' conditions, that might have accompanied a glacial age, to those of the much drier 'Present Period', wherein seasonal temperature variations are more extreme. Such an hypothesis appeared to be supported by the geological record of South Australia.

Intellectual fashion also provided powerful precedents. Charles Lyell suggested in the first volume of *Principles of Geology* that loss of climatic equability explained extinction in the fossil record. He later rejected it as a single cause in favour of a complex multi-causal approach involving human overkill as well as changes in environmental variability, but continued to regard climatic equability as one of several possible mechanisms for effecting changes in geographic distribution. As late as February 1869, discussing the many riddles of biogeography with Alfred Russel Wallace, he wrote that

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5 R L Tate, 'Anniversary address of the President for 1878-9', *Transactions and proceedings and report of the Philosophical Society of Adelaide, South Australia* 2, 1879, lxvi-lxvii.

6 For example, Tate, 'Anniversary address for the President for 1878-9', lxiv; idem, 'Glacial phenomena in South Australia', *Report of the first meeting of the Australasian Association for the Advancement of Science, Sydney*, 1887, 231-2; idem, 'Anniversary Address of the President for 1894-95', *Transactions of the Royal Society of South Australia* 19, 1895, 276.

7 Tate, 'Century of geological progress', 43; idem, 'Anniversary Address of the President for 1894-95', 276.

8 Charles Lyell, *Principles of Geology, Being an Attempt to Explain the Former Changes of the Earth's Surface by Reference to Causes now in Operation*, volume 1 (London: John Murray, 1830), 96.

The more I think over what you said yesterday about the Geographical distribution of tropical animals & plants in the Glacial Period the more I am convinced that Darwin's difficulty may be removed by duly attending to the effect of the absence of cold. The intensity of heat whether in the sea or in the air is not so important as you remarked as uniformity of temperature.\(^{10}\)

Following Lyell, Charles Darwin considered loss of climatic equability as well and although he never published on the topic, the issue continued to feature in his private correspondence and notes. For instance, he speculated to Lyell in October 1861 that 'the N. American view of warmer or more equable period, after great glacial period [becomes] much more probable in Europe'. Similarly in November 1860 he wrote to Lyell that 'a slightly different or more equable & humid climate, might have allowed … the plants in question to have grown along the entire western shores between Spain & Ireland and that subsequently they became extinct'.\(^{11}\)

Other scientists such as the French palaeontologist, Edouard Lartet, in 1867 and the gradualist botanist, Gaston de Saporta, in 1870 and 1876, invoked the phenomenon to explain peculiar faunal and botanical relationships. For Saporta the implications of the relationships within mixed floral assemblages he documented in France upset received ideas on the climate of a Glacial Epoch: 'Glacial expansion is a phenomenon without direct relation by itself with the rigour of cold'.\(^{12}\) Alfred Russel Wallace at times also appealed to a glacial epoch as an agent for gradual faunal replacement and discussed the matter extensively with Charles Lyell between 1864 and 1869.\(^{13}\)

The archaeologist Donald Grayson claimed in 1984 that 'the equability of glacial climates as an explanation for the co-occurrence of northern and southern mammals … never gained much popularity during the nineteenth century. Since that

\(^{10}\) Charles Lyell to Alfred Russel Wallace, 2 February 1869 (British Library Manuscript, Add. 46435, Alfred Russel Wallace Papers, 1064B, 97-8 (henceforth Wallace Papers).

\(^{11}\) Charles Darwin to Charles Lyell, [1 October 1861], Cambridge University Library Darwin Papers, DAR 146: 274; DAR 146: 261. For other examples, de Beer, 1960, Darwin's notebooks on transmutation of species, Part II, Second notebook (July 1837 – February 1838), 86; Grayson, 'Nineteenth-century explanations', 18-20.

\(^{12}\) Saporta cited in Grayson, 'Nineteenth-century explanations', 19.

\(^{13}\) Grayson, 'Nineteenth-century explanations', 29; A R Wallace, 1876, The Geographical Distribution of Animals, vol. 1, 151; C Lyell to A R Wallace, 2 February 1869 (Wallace Papers, 97-8).
was the case, the loss of equability as a cause of Pleistocene extinctions also did not gain much popularity. But the private correspondence of Darwin, Lyell and Wallace (see references above and below) suggests that later in the nineteenth century, all three naturalists favoured multi-causal mechanisms for extinction that involved some form of climate change from 'equable' to 'less equable' or extreme conditions.

Like Lartet and Saporta, Tate assumed a glacial period was accompanied not by drastic cold but rather by dramatic uplift of the land – an assumption he supported with reference to the raised beaches found around Adelaide, at Aldinga, Brighton and Port Wakefield for instance – and by increased humidity and greater run-off – suggested to him by the now dry lakes and creeks of the state. Uplifted peneplains allowed snow to collect at altitude and form great ice sheets above the coastal plains, despite the potentially milder climate. With the depression of the land and retreat of glaciers would come increasingly distinct seasons; hot dry summers and cold dry winters. As well as a harsher climate, the terrestrial fauna now had to contend with the reduction in fertile country and a relative rise in sea-level as the peneplain sank below it. The 'less adapted and less easily modifiable' disappeared.

Tate also espoused a multivariate approach in keeping with Wallace, Darwin and Lyell and allowed for human overkill and competition from introduced species such as the dingo as contributing factors: 'Man and dog may have together pursued the Diprotodon, … indeed, no other cause of extirpation of the huge mammals has suggested itself to the mind of Professor Owen save that of human agency'. However, a human mechanism for the extinction of megafauna did not for Tate rule out a gradual decline:

This period may be considered as the commencement of the actual

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15 Tate, R L, 'Elementary geology lectures: Notes and sketches', unpublished notebooks, Ralph Tate – Notebooks, 2 vol, [1894?-1901], Barr Smith Special Collections, University of Adelaide, Adelaide, MSS 0016, 35, 45, 46, 80.
16 Tate, 'Anniversary address for the President for 1878-9', lxix-lxiii; 1893, 43; idem, 'Elementary geology lectures', 34; idem, 'Anniversary Address of the President for 1894-95', 276.
17 Tate, 'Anniversary address for the President for 1878-9', lx-lxix; idem, 'Elementary geology lectures', 33-47.
18 Tate, 'Anniversary address for the President for 1878-9', lxix.
19 Tate, 'Anniversary address for the President for 1878-9', lxix-lxx.
period when there existed a group of animals composed for the most part of living species which date their origin from this period, and since its commencement there has been no violent but only gradual, and probably successive extinction of certain remarkable sp. … The presence of man in this period may explain the extinction of certain species, for he was certainly their contemporary.20

Donald Grayson indicated that after 1859, responding to archaeological work at Amiens and Abbeville, France, by the French civil servant Jacques Boucher de Perthes, demonstrating the contemporaneity of human and Pleistocene mammalian remains, Lyell's 'position on these issues changed sharply'. By the date of the publication of *Geological Evidences for the Antiquity of Man* in 1863 he had shifted from rejecting co-existence, to embracing 'the view that people may have helped cause the extinction of some of Europe's Pleistocene mammals'.21

However Lyell rejected human overkill as a mechanism for extinction in the fossil mammal record of Australasia in 1867 in a series of letters to Wallace. For example, he wrote in April of that year that 'No savages could have extirpated mammalia, besides we should have found them fossil in the same places with all those species of extinct Dinornis which have come to light', and in July, 'the absence of mammalia dates far back in such cases & cannot be explained away by supposing that the earliest men extirpated them'.22

Ralph Tate's assumptions as to the timing of glaciation of South Australia – and hence causal mechanism for the extinction of the Australian giant 'Pliocene' fauna – appear to have undergone some revision between 1894 annotations in lead pencil to his 'Elementary geology lecture' notes and amendments in red ink which he probably made post-1896.23 This corresponds to his investigation of the timing of the Hallett Cove glacial features, as a member of the Glacial Committee of the Australasian Association for the Advancement of Science after 1893. the committee also included the Methodist preacher Walter Howchin and Tannatt William

20 Tate, 'Elementary geology lectures', 80.
22 C Lyell to A R Wallace, 4 April 1867; 3 July 1867 (Wallace Papers, 97-8).
23 Tate, 'Elementary geology lectures'. 
Edgeworth David, the recently-appointed Professor of Geology at the University of Sydney. Tate still seemed unwilling to concede as early a date as the Permo-Carboniferous age proposed by Howchin in 1895 and may have leaned toward a Cretaceous age. Like his counterparts in Britain, Tate read the landscape and its fossil productions to support his theories on the distribution and transformation of species. As he wrote in 1893, 'the geological history of its past and present configuration' is 'intimately connected with the origin and distribution of life in Australia'.

_In a world of change scenery is the most ephemeral of things'_: Continental extension before continental drift in a 'popular science' format

Seventy five years after Tate's 'Retrospective Glance', Charles Laseron, in an intellectual environment which still had not accepted the efficacy of plate tectonics for describing the vagaries of geographical distribution, wrote about the glacial landscapes of the Fleurieu Peninsula as marvels of preservation:

Nature for once is acting as a picture restorer, carefully removing coats of old varnish to reveal the rich tones of an old master … The picture beneath is an old hilly landscape overridden by an ice sheet … On Rosetta Head we stand on a fragment of Permian landscape just as it existed 200 million years ago. But what a different vista there must have been then. Now far to the south the ocean stretches from our feet to the far Antarctic continent. To the east and to the west the Southern Ocean completely encircles the globe, except where South America pushes a long tongue southwards … In Permian times it was not thus, for somewhere beneath this expanse of water lies the lost continent of Gondwanaland, a land never seen by human eyes, but whose existence can readily be demonstrated. Where exactly it lay we know not, whether it joined Australia with South America across Antarctica, or whether it lay across the Indian Ocean to South Africa. This at least is known, that Australia then stretched far to

24 Tate, 'Anniversary Address of the President for 1894-95', 276; Barry Cooper, pers. comm., 26 January 2000.

25 Tate, 'Century of geological progress', 40.
the south, that high mountains towered over what is now the sea, far beyond the horizon … And the evidence – it is here at our feet – is found in a hundred places, in Victoria and Tasmania also, in the Permian rocks near the South Pole, in South Africa, South America, even India […]

Glacial ice leaves in the face of the land very definite evidence of its passing … which may remain ages after the ice has melted … There are many such ice-striated pavements in South Australia, Victoria and Tasmania belonging to the Permian Period … This was land ice, for no sea ice ever overrode the land to this extent … it must have come from high land, for ice like a river moves downhill. Thus the former presence of continental land south of Australia is clearly demonstrated, and though its extreme limits are unknown, it was clearly of considerable extent.26

Whereas Tate wrote for the scientifically-informed members of a reinvigorated Adelaide Philosophical Society, the Antarctic explorer Laseron's account attempts to chronicle landscape evolution in Australia for a popular audience. Tate proposed a radical re-interpretation of South Australia's recent climatic history to account for features in the landscape and fossil record, operating with a drastically curtailed, but expanding, timescale. Laseron produced an accessible synthesis of old geological paradigms and consciously avoided discussion of newer theories to explain geological change. Operating with a much longer time frame but without a mechanism to account for the lateral movement of land masses, he ignored the as yet far-fetched theory of continental drift altogether in favour of a laborious discussion of continental extension to explain continental associations and prove the former existence of 'the mysterious continent of Gondwanaland' to the south.27

The Kaurna interpretation explained recent and ongoing landscape processes, while Tate's and Laseron's accounts were conjectural rather than exegetic. They concentrated on glacial processes, which Tate initially located in the Pliocene Epoch and Laseron, in line with prevailing explanations, located in the Permian. All three

27 Laseron, The Face of Australia, 171.
accounts invoke mechanisms for geomorphological and biogeographic change to interpret modern processes, patterns and signs of age in the landscape. But the Hallett Cove landforms reveal the conjunction of many distinct geographies, making the location a veritable theme park. So I want to juxtapose the three previous snapshots with a modern diorama, or geological history, a gross simplification of events, built from 125 years of scientific examination, that could have contributed to the modern form of Hallett Cove.

*Preservation and change in an 'outdoor museum': A modern diorama*

Geological exegesis lends itself to 'scene by scene' presentation. This sleight of hand invests broken sequences of fragmented and twisted earth and rock with a determinism which simplifies and obscures both the degree of sophisticated supposition and practical science which produce geological narrative. It is a useful cognitive tool.

The present landscape at Hallett Cove is old. It has been forming and changing for more than 600 million years. But in one small section south of Waterfall Creek is represented all of the events in the following diorama (Plate 8).

**Panel 1**

The first panel is represented by the oldest rocks exposed in the park: the red mauve siltstones of the Brachina Formation at Black Cliff. These are vestiges of the formerly flat-lying sands and silts of a tidal flat on a continental shelf about 600 million years ago. Australia was then part of what is called the Gondwanan supercontinent along with the lands that now make up Antarctica, South America, Africa, Madagascar, New Zealand and India. For millions of years previously sediments eroded from the low land to the west into a series of shallow seas – the large sedimentary basin now known as the Adelaide Geosyncline – which might have extended from the present position of Kangaroo Island, beyond Lake Eyre, into Central Australia. In the process of filling the depressions, these sediments subsided under their own weight. As their

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29 My own sleight of hand borrows heavily from the information contained in Scrymgour's 'scenes' and Giesecke's 'snapshots', but I have termed them 'panels', in keeping with the panorama motif of Chapter One, Part One.
water content reduced, sands in shallower water became the sandstones and in deeper water silts and muds became the siltstones and shales of the tidal flat. Eventually over the next 100 million years, the deeply buried sediments were altered by heat and pressure into the hard rock exposed at the cliff line today. Life had not yet colonised the rocky land, but algae and multicelled organisms like jellyfish appeared in the sea.

Panel 2

The Black Cliff sediments are also the modern expression of my second panel. They are the eroded remnant of a colossal mountain range, similar to the modern Himalayas, which formed in the Ordovician Period, some 500 million years ago. The land that would become South Australia was north of the equator. Large-scale crustal movements buckled the sediments of the Adelaide Geosyncline (Panel 1) in a north-westerly direction. They were folded and uplifted into a massive chain sometimes referred to as the Delamerian Mountains after the Delamerian Orogeny which formed them. This chain stretched south into Antarctica and north into central Australia. Life continued to diversify during the preceding Cambrian Period and although there was no life on land yet the oceans contained trilobites, jellyfish, molluscs and sponges.

Panel 3

My third panel – a diorama in itself – is represented at Hallett Cove by an absence. Geology values things as esoteric as 'unconformities'. An unconformity is essentially a concept rather like parentheses. It is a contact between sediments of different ages that delimits a period of non-deposition or erosion. This particular unconformity represents more than two hundred million years of landscape evolution. The Delamerian Mountains were intensely eroded, leaving no hint of these changes as they affected the cove. But elsewhere in Gondwanan Australia, Central Australia was covered by shallow sea. Fossils of bivalves, crinoids, graptolites and the first jawless fish appear in mid to late Ordovician sediments. Vascular plants colonised the land. There was volcanic activity on the 'east coast', as the Great Dividing Range formed during the Silurian. The first jawed fish appeared and diversified in Devonian seas, as did tree-sized club mosses on land. Forests appeared in swampy areas. Early amphibians and insects inhabited the land. Australia moved south of the equator. The Carboniferous began warmly, but cooled as Gondwana moved across the South Pole. Conifers evolved and insects took to the air. Glaciers began to develop.
Panel 4
The fourth panel is once more represented in the rocks at Hallett Cove. By 280 million years ago, change in the configuration of the Gondwanan lands and the sea had influenced global weather patterns. Lower temperatures and expansion of the polar ice caps ensued. Gondwana was gradually covered by a wet-based continental ice sheet, which in Australia blanketed much of the southeast. This is now known as the Permian, or Gondwanan glaciation. The flattened view might have looked something like the Antarctic ice sheet today, had there been anyone to see. As it flowed, the glacier tore rock and sediment from the land surface beneath. The resulting debris, frozen into its base, gouged, scratched and polished the denuded bedrock.

Ten million years later, during the middle Permian, the climate was warming and the ice thinned. Meltwater flowed from the surface and from under the ice depositing fine rock flour and coarser material. This accumulated in layers on the floors of meltwater lakes, as at Hallett Cove, as the glacier moved westward and northward. Floating icebergs, calved from the ice sheet, shed debris and rocks, or 'dropstones', into the sediments of the lake floor.

The vocabulary of glaciers affirms John McPhee's declaration that geology is indeed a fountain of imagery.30 Hallett Cove is no exception. Since the Permian Period it has been a premier site for dropstones, erratics, lunate fractures, crescentic gouges, chatter marks, striated bedrock, roches moutonnées (named for their resemblance to recumbent sheep), lodgement till, flow till, rock flour and tenacious clay. Verbal deposits aside, the presence of these features at the cove provides evidence of the passage of a glacier and its direction. The Proterozoic rocks of Panel 1 were grooved and gouged by the ice sheet and friction marks – lunate fractures, crescentic gouges, chatter marks, striations – remained after the ice retreated. Larger rocks trapped in the glacier or in icebergs could be transported a long way, before being dumped when the ice melted. These include the glacial erratics which rest on the beach at Hallett Cove, erode from the glacigene cliff sediments to the south and rest on the clifftops above.

Panel 5
Another parenthesis encloses the 200 million years or so that comprise the fifth panel, represented by a contact between the glacigene sediments and Pliocene sediments above. As Hallett Cove eroded during the Triassic, dinosaurs appeared. Inland Australia was covered by seas inhabited by fish and plesiosaurs. Conifers, cycads and fern prairies were common on the land. Australia and Antarctica started to separate during the Jurassic. New coastlines formed as the rifting which had begun to split Gondwana apart at the end of the Permian separated Australia and Antarctica completely by about forty-five million years ago during the middle Eocene. Flowering plants, mammals and birds diversified after the decline of the dinosaurs. Many modern groups of Australian biota had appeared by the Oligocene. At the close of the Miocene, about 5 million years ago, the climate was warm and wet.

Panel 6
My sixth panel is set four million years ago, in the Pliocene. A warm shallow sea briefly covered low-lying land to the east of the modern Gulf St Vincent. Sediments and sea shells accumulated on the sea floor, together with shellfish and the many-chambered, calcium carbonate 'shells' of single-celled marine organisms called foraminifera. These hardened to a fossiliferous sandstone, exposed two million years later, when the present Mount Lofty Ranges were uplifted. The sandstone is exposed in the Amphitheatre and also forms a bluff along the northwestern part of the park and is the modern embodiment of this panel. The next two million years or so are again not represented by the Hallett Cove rocks. Australia became warmer and drier as its northward drift continued. Abundant rainforests were replaced by grasslands and eucalypt woodland. Grazing mammals diversified.

Panel 7
In the Pleistocene Epoch, dry periods in Australia were interspersed with wet ones. During the latter, high ground eroded. As the Mount Lofty Ranges rose, sand, silt and clay washed down to the coast in streams. These thick alluvial sediments were deposited above the exposed fossiliferous sandstone. Where the land had remained above water during the Pliocene, they blanketed glacigene Permian sediments. The unconformity between is represented by Panel 5. Seasonal changes in precipitation leached calcium carbonate from the soil, which was redeposited near the ground surface in a hard layer of calcrete.
Sea level fluctuated as the Pleistocene glaciations of Europe and North America swelled and declined according to oscillations of the polar ice caps. Glacial advances correlated with sea level retreat and interglacials with marine incursions over the continental shelf. Only small areas of greater Australia – parts of Tasmania, the highlands of New Guinea and the Kosciuszko Plateau – were glaciated even at the height of the Pleistocene ice age. In fact, Pleistocene Australia could instead be said to have experienced 'dirt ages'.

Reduced precipitation and spring run-off from the highlands made a dust bowl of the interior. Plains of 'drift' – formerly attributed to great floods or glaciers – blew across the continent, forming characteristic dune systems. Sea level changes sculpted the coastlines. Upstream of their drowned deltas, rivers became coastal estuaries as the sea invaded. Coastal plain became shallow sea and plain again. The inland deltas of the Riverine Plains and the Lake Eyre basin dried out. Giant marsupials browsed the forests, grazed the plains and died horribly of thirst, trapped in the mud of drying lakes. Towards the end of the Pleistocene, the ancestors of modern Aboriginal people witnessed and adapted to these changes.

Panel 8
With the retreat of the ice caps around 10,000 years ago, the sea again began to encroach on the coastal plain of Gulf St Vincent. During the Holocene it rose more than one hundred metres. Kangaroo Island and Tasmania became islands once more. The Pacific Ocean flooded the Parramatta River delta to form Sydney Harbour. Waves cut cliffs into the stumps of the Delamerian Ranges, left a rocky platform at their base and removed quantities of soft glacial sediment from the beach, to expose Permian erratics at Hallett Cove. Uplift of the land surface enhanced erosion of Permian and Pliocene sediments by the creeks which washed down from the Mount Lofty Ranges and carved the badlands features of the Hallett Cove Amphitheatre. Low dunes formed on the beach. People of the Adelaide Plains occupied sunny sites along the cliffs, in the lee of the prevailing winds. These cycles of erosion, deposition  

31 For example, see discussion in Kirsty Douglas, 'Scarcely any water on its surface', in Words for Country: Landscape and Language in Australia, eds Tim Bonyhady and Tom Griffiths (Sydney: University of New South Wales Press, 2002), 68-83.

and uplift continue today (see Plates 9, 10, 11, 12 and 13 for pictures of late Proterozoic and Permian landforms at the cove and possible mechanisms for their formation).

This is deep time at Hallett Cove in broad brush strokes. But it is not just the story in the sediments that makes the site iconic to South Australian geologists. Hallett Cove is what the Geological Society of Australia terms a 'Classical Site' – a canonical location associated with the development and articulation of geological concepts – in this case, nineteenth-century glacial studies in Australia.33 Which leads me to the investigation of the deep past as it relates to the invention of glaciology during the nineteenth century.

Chapter V

'bent upon covering the whole continent with ice': Glacial studies in the nineteenth century

What a grand new feature all this ice work is in Geology? – How old Hutton would have stared!1

Natural science and the invention of the Ice Age
Much nineteenth-century interest in the advance and retreat of glaciers stemmed from attempts to explain the same phenomena that concerned naturalists engaged in debate about the nature of other changes in the geological record. These phenomena included unusual associations, extinction in the fossil record, 'diluvium', erratic boulders, unexplained scratches and grooves on rocks. In Theory of the Earth; Or, an Investigation of the Laws Observable in the Composition, Dissolution, and Restoration of Land Upon the Globe, published in 1795, the Scottish geologist James Hutton described the motion of former glaciers as accounting for boulders in alpine regions of Scotland. Others, through independent observation, increasingly reached similar conclusions.

Then in 1834, Jean Louis Rodolphe Agassiz, the 27-year-old Swiss-born naturalist, former student of Georges Cuvier and recent adherent to Charles Lyell's ice-rafting theory, heard of the 'glacial theories' of his former teacher, the Swiss naturalist Jean de Charpentier, and a civil engineer called Ignace Venetz. In the summer of 1836, a sceptic, he travelled to Bex in the Rhone Valley. Once there, confronted by the landscape and Charpentier's explanations in the field, he changed his mind.2

On 24 July 1837, as President of the Swiss Society of Natural Science, he presented a paper – later published as the Discours de Neuchâtel – which posited widespread glaciation in the recent past. By proposing cyclical cataclysmic cold his glacial theory accounted for unexpected associations in the fossil record and for the

1 Charles Darwin to Charles Lyell, [12 March?] 1847 (DAR 146: 147).
phenomenon of extinction. The former great extension of glaciers explained the presence in the landscape of many features previously difficult to rationalise. He compared the earth to an organism – initial 'vigour' and high temperature, followed by a 'stepwise' decrease in temperature and vigour through several ages, each of which was separated by a period of stasis, when 'Death enveloped all nature in a shroud'.

It was the ultimate anti-transformist, anti-gradualist, catastrophist manifesto, with cyclical, cataclysmic glacial periods in place of cyclical, cataclysmic deluge. He did not admit of any kind of evolutionary model, but insisted on the immutability of species and complete faunal replacement between each successive age. He saw the unfolding of life as progressing toward humankind in discontinuous steps, and on this he appears not to have wavered during his career. In 1837 he met with certain opposition. The meeting reportedly turned into a heckling match between the great German naturalist Leopold von Buch and Agassiz who soldiered on nonetheless. Despite opposition to the detail of the theory, Agassiz's numerous field trips, papers and lectures established glacial studies as a credible branch of the natural sciences.

On one of these field trips in 1838, William Buckland accompanied Agassiz to the Alps but remained unconvinced by his friend's 'snowy humour'. Mainstream acceptance in Europe was perhaps catalysed in 1840 when Agassiz published *Etudes sur les glaciers*. Here he added the proviso that human beings did not appear until after the last catastrophe. Also in 1840, the previously equivocal Buckland publicly accepted the efficacy of glacial theory for explaining changes on the earth including phenomena hitherto explained by a widespread or universal deluge. However, despite Buckland's public capitulation, acceptance in Great Britain came slowly. As James Geikie wrote to Darwin in 1876,

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4 Grayson, 'Nineteenth-century explanations', 11.


In speaking of the glacier theory having preceded that of icebergs I was referring to the fact that Agassiz was the first to point out that glaciers had formerly existed in our islands. Up to that time (1840) I do not think anyone had suspected that this was the case. But after that time the iceberg theory came prominently forward. No doubt it was not for a number of years subsequently that what is now called the glacier theory came into vogue.9

Even Charles Lyell accepted that glaciation had once been more extensive,10 but he baulked at Agassiz's non-gradualist approach to faunal replacement and geological change. To Lyell, it was not a simple case of replacement of Great Flood with Great Cold as an 'ideal force' which would 'effect whatever it is required to do & supercede almost every other agency'.11 He was unwilling to compromise his uniformitarian paradigm. Until conclusive evidence of the great extent and destructive power of modern, continental-scale ice sheets at the poles – as a contemporary geological force operating in the modern world, and hence assimilable into Lyell's doctrine – was published in the 1850s, he struggled to come to terms with the notion.12 However, once convinced, he embraced it as further proof of the operation of gradual forces to effect changes in the earth.13

Agassiz remained a catastrophist. In 1866 (Geological sketches) he extended his theory to glaciers of the New World, gleefully using such evidence to strike a blow against transformationists like Darwin, by 'demonstrating' that cold had eliminated life in the fairly recent past all over the globe.14 Darwin told Lyell in September of 1866 that 'I quite follow you in thinking Agassiz Glacier-mad' and

10 Agassiz, Louis Agassiz, 309.
11 See C Lyell to A R Wallace, 24 March 1869 (Wallace Papers, 113-28): 'I foresee that until we obtain a more certain knowledge of the manner in which ice can erode rocks & the rate at which it can cut through & above all, its power to throw out the broken rock or sand or mud to which it gives rise by erosion we shall be in the dangerous possession of an ideal force which like the old fashioned "convulsion of nature" or catastrophe or diluvial wave of our predecessors is able to effect whatever it is required to do & to supercede almost every other agency'.
12 Bolles, The Ice Finders, 49-51.
14 Jean Louis Rodolphe Agassiz, Geological Sketches (Boston: Ticknor and Fields, 1866).
lamented that a man of his energy and 'imagination' had not been raised a gradualist: 'What a splendid imagination Agassiz has! How energetic he is! What capital work he would have done if he had sucked in your "Principles" with his mother's milk – It is wonderful that he should have written such wild nonsense'.

The Harvard botanist Asa Gray wrote to Darwin in August of the same year that Agassiz was 'bent upon covering the whole continent [of America] with ice' to refute the continuity of life 'from tertiary or post tertiary period to ours', and with it gradualist and transformist theories of change in the fossil record:

Agassiz is back (I have not seen him), and he went at once down to meeting of National Academy of Sciences – from which I sedulously keep away – and, I hear proved to them there that the glacial period covered the whole continent of America with unbroken ice, and closed with a significant gesture and the remark "So here is the end of the Darwin theory"! How do you like that. I said last winter that Agassiz was bent upon covering the whole continent with ice. – and that the motive of the disarray he was sure to make was to make it sure that there should be no coming down of any terrestrial life from tertiary or post tertiary period to ours. You cannot deny that he has done his work effectually in a truly imperial way!

Darwin himself supposed at the time that 'the whole world was cooler during the Glacial period' but, based on vegetation of New Zealand and the west coast of South America, 'where Glaciers now descend to, or very near to the sea', felt it 'rash' thereby to conclude 'that all tropical forms would be destroyed by a considerably cooler period under the Equator'. He also felt ambivalent about possible mechanisms for survival of tropical species in a fully glaciated globe, and debated with and about the English botanist Joseph Hooker on the same topic, as for example, in this letter to Lyell of 16 February 1866. Hooker insisted that 'certain orders of plants' which had survived to the present could not have withstood the cooler climate,

15 Darwin to Lyell, [8 September 1866], (Cambridge University Library Darwin Papers, DAR 146: 297).


17 Darwin to Lyell, [7 February 1866] (DAR 146: 292).
a difficulty Darwin acknowledged with playful reluctance:

I do not at all suppose that nearly all tropical forms were exterminated during the cool period … Hooker's paper in Nat: Hist: Review is well worth studying, but I cannot remember that he gives good grounds for his conviction that certain orders of plants could not withstand a rather cooler climate … We have only just learnt under how cool a temperature several tropical orchids can flourish. I clearly saw Hooker's difficulty about the preservation of tropical forms during the cool period, & tried my best to retain one spot after another as a hot house for their preservation: but it would not hold good and it was a mere piece of [word illegible] on my part when I suggested that longitudinal belts of the world were cooled one after the other … but a squabble with or about Hooker always does me a world of good and we have been at it many a long year. I cannot understand whether he attacks me as a Wriggler or a Hammerer but I am very sure that a deal of wriggling has to be there.18

So the reality of past glaciation, at least in the northern hemisphere, was widely accepted among the European geological fraternity by the late 1850s, though how widespread, and exactly what its effects had been was debatable. For much of the rest of the century, the topic played at the intellectual imagination of geologists, botanists, comparative anatomists, zoologists and physicists alike: 'Interesting as many chapters are in the history of the world I do not think that any one comes nearly to the glacial period or periods', wrote Darwin to Geikie in 1876. Speculation, public and 'private', about the causes of glacier extension, was rife.19

Resolving 'the agencies in operation'
The difficulty remained of finding a mechanism. In 1864, James Croll, then working

18 Darwin to Lyell, [15 February 1866] (DAR 146: 293).
19 Quote is from Darwin to J Geikie, 16 November 1876 (Cambridge University Library Darwin Papers, DAR 144). For similar sentiments, see also Darwin to Lyell, [12 March?] 1847 (DAR 146: 147). For other examples, see letters between Charles Lyell and Alfred Russel Wallace (Wallace Papers, Lyell to Wallace, 104-110, 15 March 1869), Croll and Lyell, and Darwin, Croll and Wallace (Wallace Papers, 194-5: Croll to Wallace, 28 September 1870), collections of British Library and Cambridge University Library Darwin Papers.
as a 'janitor' at the Andersonian College and Museum in Glasgow, but from 1867 a member of the Geological Survey of Scotland, published his theories on earth movement.20 Croll examined ocean currents and temperatures, trade winds and minute changes in sea level to come up with a fairly integrated account of glacial advance and retreat through time. He proposed that the earth has cycles of tens of thousands of years wherein it varies minutely in its course over time due to three factors:

- eccentricity of its orbit;
- precession of the equinoxes, or change in the direction of earth's axis as it turns around the axis of the ecliptic;
- axial tilt.

Such phenomena cause fluctuations in the amount of solar radiation reaching the earth's surface. Reduced radiation corresponds to colder temperatures and glacial advances. Increased radiation corresponds to warmer temperatures and glacial retreat. 'Agencies brought into operation' by the increased eccentricity of earth's orbit (its variation from almost circular to elliptical) result in changes in the strength and direction of trade winds, which in turn influence ocean currents and the differential heating and cooling of the hemispheres.21

In effect, Croll proposed long secular summers and winters, 'depending as truly as the annual ones do upon planetary motion and, like them, also fulfilling some important end in the economy of nature'. Annual seasonality compounds the effects of secular seasonality. When the 'excentricity is about its superior limit', physical causes combine to lower to a very considerable extent the temperature of the hemisphere whose winters occur in aphelion, and to raise to nearly as great an extent the temperature of the opposite hemisphere, whose winters of course occur in perihelion'.22 Perihelion is the point in its elliptical orbit that the earth is nearest to the

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20 J W Croll, 'On the physical cause of the change of climate during geological epochs', *Philosophical Magazine* 28, 1864, 121-37; idem, 'Physical cause of the submergence of the land during the glacial epoch', *Philosophical Magazine* 31, 1866, 301-5; idem, 'The change in the obliquity of the ecliptic, its influence on the climate of the polar regions and on the level of the sea', *Philosophical Magazine* 33, 1867, 426-45; idem, 'On the physical cause of the motion of glaciers', *Philosophical Magazine* 37, 1869, 201-8. For biographical detail see John and Mary Gribbin, *Ice Age* (London: The Penguin Press, 2001), 31.

21 Croll, 'The change in the obliquity of the ecliptic', 430-445.

22 Croll to Darwin, 2 December 1868 (Cambridge University Library Darwin Papers, DAR 50 series 5).
sun. At aphelion, it is furthest away.

He reflected in 1868 in a letter to Darwin on the 'curious circumstance' that 'all the agencies in operation should tend to one effect viz the production of snow on the one hemisphere and the melting of it on the other'. He called it 'the grand secret of the Glacial Epoch', whereby the 'heat was all pushed to the one side of the equator and the cold and moisture to the other side'. Even 'the very nearness of the sun during summer tended to increase the amount of snow falling'. By extension, contemporaneous southern and northern hemisphere glaciation is impossible. When the northern hemisphere is icy, the southern enjoys a gentle summer of many generations' duration and 'the entire mass of ice which presently exists in the southern hemisphere would be transferred to the northern, leaving the quantity of liquid water unchanged'.

Croll's theory was widely discussed in the 1860s and 70s. Sir William Thomson, Lord Kelvin, accepted many of Croll's ideas, which had ramifications for arguments about the age of the earth. In 1869, Lyell, who was not entirely enthusiastic about secular summers and winters and the notion of a warm southern hemisphere while the northern was glacial, worried to Wallace that Darwin had not taken enough account of his objections, or thought Croll's theories through: 'Darwin has [not] given any time or thought to Croll's eccentricity theory or to my chapter'.

But from 1868, Darwin produced an extensive correspondence on the topic, with

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23 Croll to Darwin, 2 December 1868 (Cambridge University Library Darwin Papers, DAR 50 series 5).
24 Croll, 'Physical cause of the submergence of land', 305.
25 Scoular, 'The geology of the Hundred of Munno Para'; Tate, 'Elementary geology lectures', 34.
26 C Lyell to A R Wallace, 2 February 1869 (Wallace Papers, 97-8): 'It is for those who maintain the violent contrast of the climate of the two Hemispheres in the Glacial Period to show us Quaternary or Post Pliocene deposits occupying a position 25° north & south of the Equator full of types proper to our temperate region & with such an absence of tropical forms as would imply that these had been annihilated even at a moderate height above the level of the sea. I know of no evidence of this kind, and I don’t think that Darwin has given any time or thought to Croll’s eccentricity theory or to my chapter upon it, and I wish much that he could see your [word illegible] before he came out with this new edition of "The Origin" For I am afraid that he will make too much of the supposed corroborat ion afforded by the imaginary warmth of the Southern Hemisphere, of the equally hypothetical expulsion of tropical forms from the equatorial zone north of the line. See J W Croll to C Darwin, 4 February 1869, DAR 161.2: 263, and 2 December 1868, DAR 50, series 5: 3-8 for Croll's differing view on the matter: 'I have not as yet been able to overtake that part of the question relating to the condition of the hemisphere whose winters occur in perihelion. I have no doubt that when this part of the subject has been fully discussed [Lyell] will agree with me; The facts in favour of a warm climate are as numerous and strong.'
Croll himself, with Lyell and Joseph Hooker and with James Geikie among others.27 As he wrote to Hooker in November 1868, having 'read Croll', a 'wonderful man', he was 'almost convinced' that the 'level parts' of North America 'must have been covered with sheet of glacier ice'. He wrote to Croll the same month 'about the alternation of glacial & warmer periods in N. & S', hoping, as he told Hooker, to 'remove' the botanist's objections to cool period extending to Equator, by allowing 'temporary migration of equatorial flora northward. I thought myself compelled to [assume] [the] whole world was simultaneously cooler. It will be an immense relief'.28

Although running contrary to evidence Darwin had observed in the field, Croll's notion of secular seasonality helped the naturalist solve the difficult issue of geographical distribution of plants and animals and their re-population after a glacial period:

Am I right in supposing that you believe that the glacial periods have always occurred alternately in the Northern and Southern Hemispheres, so that the erratic deposits which I have described in the S. parts of America, and the glacial work in New Zealand could not have been simultaneous with our glacial period[?] From the glacial deposits occurring all round the Northern Hemisphere, and from such deposits appearing in S. America to be as recent as the north, and lastly, from there being some evidence of the former lower descent of glaciers all along the Cordilleras, I inferred that the whole world was at this period cooler. It did not appear to me justifiable without distinct evidence to suppose that the N and S glacial deposits belonged to distant epochs, though it would have been an immense relief to my mind if I could have assumed that this had been the case.29

Broadly speaking, Croll's astronomical ideas accord with modern scientific orthodoxy about the advance and retreat of ice within the longer cycles of major

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27 For example, see letters Croll to Darwin, 23 Sep. 1868; 2 December 1868; 4 February 1869; 23 June 1869 (Darwin Papers, DAR 161.2 254-278); Darwin to Croll, 19 Sep. 1868; 24 November 1868; 31 January 1869; 6 February 1869 (DAR 143).

28 Darwin to J D Hooker; 26 November 1868 (DAR 94), ref. Darwin to Croll, 24 November 1868.

29 Darwin to Croll, 24 November 1868, Cambridge University Library Darwin Papers, DAR 143.
glaciations, but in reverse. Although widely discussed in scientific circles the 1870s they fell out of favour in the later nineteenth century when weight of evidence began to suggest that the last ice age ended around 10,000 years ago, not 80,000 as Croll's model suggested. Between 80-100,000 years ago, when according to Croll's model the earth should have been warming, it was again plunging into an ice age.30

Despite its flaw, the astronomical model provided an important beginning to deciphering cycles of glaciation. More of the answer was to be found in an echo of Ralph Tate's ideas about glacial climatic equability discussed in Chapter Four. Croll assumed that extreme temperatures trigger ice ages: the hemisphere in which winter occurred at aphelion enters an ice age, as winter is colder and the fact of hotter summers simply results in more precipitation, and therefore more snowfall at high latitudes. It seems instead that the fiercer summers in this hemisphere ensure that ice melts annually, instead of growing into glaciers. Glacial conditions are triggered instead when summer falls at aphelion. These cooler summers may limit the amount of ice that melts at high latitudes, facilitating the growth of ice sheets. Positive feedback then ensures they grow. This corrective to Croll's by now discredited theory was offered in the 1920s, when the Serbian astronomer Milutin Milankovich proposed similar ideas, in cooperation with meteorologist and the grandfather of plate tectonic theory, Alfred Wegener and his son-in-law Wladimir Köppen.31 Counter-intuitively, it seems summer is the key season in the inception of glacial intervals. Milankovich Cycles fell out of favour in the mid-century as well, to be revived in the late 1960s.

'Ice Ages' are now understood as falling into two categories, on two different time scales. Long, cool intervals of earth history, on a scale of tens to hundreds of millions of years, during which glaciers wax and wane, are distinguished from shorter periods within these longer intervals, of tens of thousands of years, when glaciers are at their maximum extent. For the sake of convenience, the former are here termed 'icehouses' or glacial supercycles. The latter are termed glaciations, glacial maxima, or ice ages, and are separated from each other within the icehouses by warmer interglacials.

Croll's theories explain the latter more completely than the long interval

icehouses. The existence of these supercycles further explains the deficiencies in his synthesis. Naturally, the bulk of his data related to the most recent glaciation, that of the terminal Pleistocene, which ended about 10,000 years ago, when indeed, the northern hemisphere was icier than the southern. The existence of cyclic icehouses was barely hinted at. However, one of the ground-breaking implications of Croll's work was the inference, drawn above in the letter from Darwin of November 1868, that the 'N and S glacial deposits' must have 'belonged to distant epochs' and 'the glacial work in New Zealand [and South America] could not have been simultaneous with our glacial period'. This set the scene for the re-interpretation of landforms at Hallett Cove as relics of a far more ancient glacial period than Ralph Tate's hypothesis of 1877 allowed.

The icehouses appear to be concentrated in at least four different intervals, in the Neoproterozoic (at about 800-600 million years ago); the Ordovician-Silurian (from 460-430 million years ago); the Permo-Carboniferous (roughly 350-250 million years ago); and the late Tertiary-Quaternary (the last approximately four million years). Of these, the latter is the best understood. The last two million years have seen over twenty advances and retreats of continental ice sheets.

The causes of glacial supercycles are understood less well than causes of ice advance and retreat within them. They appear to be the culmination of even longer periods of global cooling, for tens of millions of years before the icehouse commenced. It seems that many factors produce conditions favourable for icehouses and the inception of 'permanent' ice, from the changing lateral position of the continents (on which, in the absence of plate tectonic theory, neither Croll nor Milankovitch was in a position to speculate), to uplift of continental blocks, to fluctuations in atmospheric carbon dioxide ('greenhouse' and 'icehouse' effects), to the destabilisation of gas hydrates (linked to sea-level fluctuations), to orbital changes.

The presence of large land masses at high latitudes is a prerequisite for the formation of glaciers, as such large accumulations of ice cannot form over deep ocean. There is evidence from the Neoproterozoic and from the Permo-Carboniferous icehouses of such 'super-continents' at one or other of the poles. Once the ice begins to form, it becomes a self-propagating system, as snow and ice reflect sunlight back

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32 Darwin to Croll, 24 November 1868, Cambridge University Library Darwin Papers, DAR 143.
into space much more effectively than rock and water. As albedo increases, the earth becomes colder, more ice forms, and the effects of albedo increase further. For example, during the Permian icehouse most of the land was still concentrated at the South Pole in one super-continent now known as Pangaea, thereby maximising the effects of albedo, whereas during the later Cretaceous greenhouse the continents had dispersed.33

Changes in the lateral position of continents affect ocean currents. For instance, the separation of Antarctica and Australia created a circumpolar ocean – the Southern Ocean – which isolated the polar continent and may have facilitated the growth of the Antarctic ice-cap. Uplift affects atmospheric circulation as well as oceanic, as with the great elevation of the Himalayas and the Tibetan Plateau over the last fifteen million years. An increase of land at higher altitudes also encourages the build-up of ice and snow.

Carbon dioxide is a greenhouse gas. A reduction in atmospheric CO2 may cause an overall reduction in the temperature of the atmosphere and the oceans. The amount of the gas in the atmosphere at any time is a result of complex interactions between organisms, ocean currents, erosion and vulcanism, and it is unclear whether the temperature reduction or the CO2 reduction occurs first in an icehouse. The magnitude of the changes over time is also unclear. However, some commentators suggest that carbon dioxide from volcanoes and submarine vents might have caused a sufficient build-up of atmospheric CO2 during the proposed 'snowball earth' scenario of the Neoproterozoic that runaway greenhouse conditions triggered a melting of the ice, before the cycle began again, over tens of millions of years.34

'Snowball earth' theorists also suspect that the destabilisation of gas hydrates may act upon super-cycles. Gas hydrate is a crystalline solid consisting of gas molecules, usually methane. Large amounts of methane and CO2 is locked up in marine gas hydrate reservoirs. When the sea level drops during a glaciation, these melt. This has a negative-feedback effect and can prolong super-cycles.35

Variations in the earth's orbit trigger changes in the amount and distribution

35 Dr Brett Marmo, email, 17 March 2004.
of solar radiation. This both initiates and affects the course of glaciation. But the cycles of orbital variation are too short to explain icehouse-greenhouse super-cycles and are probably more important for controlling local variation within the larger intervals. It is these more localised changes that Milankovitch's and Croll's theories best explain.

During the 1960s and 70s, new data relating to the above theses generated broad support from the scientific community for Milankovitch's ideas. He had proposed that glacier advance and retreat within glacial supercycles are mainly due to changes in the amount and distribution of solar radiation reaching the earth's surface. These fluctuations affect the development of continental-scale ice sheets, and result from the same three factors earlier isolated by Croll: orbital eccentricity, axial tilt and the precession of the equinoxes. These all have different periodicities of variation, and changes also vary with latitude and seasons, rendering the composite variations in solar radiation very complex indeed. They are now termed Milankovitch Cycles. Data from the last 750,000 years has revealed something of the periodicities and the effects of these three factors.

Cyclical changes in the eccentricity of earth's orbit – which varies from between 1% and 5% over time – result, as Croll suggested, in seasonal contrast between the northern and southern hemispheres. When the orbit is highly elliptical, one hemisphere will have hot summers and cold winters and the other will have warm summers and cool winters. When the orbit is close to circular, the seasonal temperature contrast will be similar across the hemispheres. The positions and timing of aphelion (the point in its orbit that the earth is furthest from the sun) and perihelion (the point in its orbit that the earth is nearest the sun) also effect fluctuations in the amount of solar radiation that reaches the surface. These orbital changes have a periodicity of roughly 100,000 years.

The tilt of earth's axis from the ecliptic – the plane of its orbit – varies from 21.6° to 24.5°. It is currently 23.5°. Over the last 750,000 years, the dominant period of variation has been about 41,000 years. Changes in tilt cause significant changes in the seasonal distribution of radiation at high latitudes, and in the length of winter dark at the poles. It has very little effect at lower latitudes, but with changes in solar radiation of up to 15% at the poles, it has a huge effect on the formation of ice sheets.

The timing of the equinoxes changes because the axis of earth's rotation
wobbles 'like a spinning top'. This is known as precession, and it is closely related to axial tilt. Aphelion and perihelion change position on the orbit through a cycle of 360°, with a generalised periodicity of 22,000 years. This affects the seasonal balance of radiation. For example, if aphelion falls in July, summer in the northern hemisphere and winter in the southern will be cooler than the corresponding seasons in opposite hemispheres.

As Croll indicated to Darwin in 1868, the 'grand secret' of 'the' glacial period is the tendency 'to one effect viz the production of snow on the one hemisphere and the melting of it on the other'. This overstates the case somewhat, but still he still had a point. He was unaware of the evidence in Australia for arid 'glaciation', which was not articulated until nearly a century later. It was not so much the 'melting of it', as the absence of precipitation to make snow in southeastern Australia that produced the familiar semi-arid landforms of the region. The positive feedback effect generated during glacial supercycles can override the tendency of orbital variation to concentrate glaciers in one hemisphere or other. Croll cannot be expected to have read these effects in the rocks, as subsequent glacial activity tends to obliterate the signs of previous glaciation, so the cycles of the Pleistocene icehouse are far more easily recognisable than older supercycles.

Croll's work was well-known in Australian scientific circles by the 1870s. For example, in 1879 Gavin Scoular, a member of the Adelaide Philosophical Society and Hallett Cove glaciation naysayer, presented a convoluted account of Croll's work, in which he stated that 'it would be presuming too much … to enter here in detail upon matters with which a majority of members present are fully acquainted'. Ralph Tate's lecture notes also included a fairly detailed Australian summary of some of Croll's ideas. Clearly the acceptance of Croll's theories had ramifications for

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36 Rickard S Toomey III (Project Director), Illinois State Museum Ice Ages Exhibit, 1995, online www.museum.state.il.us/exhibits/ice-ages.


38 G Scoular, 'The geology of the Hundred of Munno Para. Part One. The Newer Tertiary rocks',
evidence of southern hemisphere glaciation.

**Glacial studies in South Australia**

So why else was glacial theory important in Australia? Intellectual fashion plays a part. Many late nineteenth-century geologists in Australia had backgrounds in glaciology in Britain or Europe, where the discipline aided in the explanation of changes in past climate and the fossil record. For example, A R C Selwyn described experiences in North Wales which enabled him to recognise signs of glaciation in Australia. Charles Fenner, in his obituary for Walter Howchin, wrote of the 'glacial hills' which 'produced the mind that later revealed to the world the existence of a glacial age infinitely older than anything previously conceived by man' (the Neoproterozoic icehouse), and Howchin himself 'had had experience of the evidences of extinct glacial action in the north of England and Scotland'. Tate, writing about the geography of South Australia, explained that 'one familiar with the appearance of a glaciated country cannot have failed to recognise a certain resemblance that our hills bear thereto'. So they searched for and imagined signs of geologically recent glaciation in Australia, comparable with the Pleistocene or 'Great Ice Age' of Europe and America, to explain equivalent changes to the landscape and fauna in a different setting.

Geographic reasons were compelling. A major part of the Australian interior consists of a low peneplain, tectonically relatively quiet with one of the lowest erosion rates known. Weathering profiles dated to the Mesozoic, and correspondingly ancient land surfaces, have survived to the present. The record in the rocks goes way back. In contrast, in Eurasia and the Americas, late-Tertiary and Quaternary uplift and glacial erosion produced very different, 'fresher' landscapes. Only in Tasmania and the higher parts of southeastern Australia are landscapes found which resemble those of western Europe. With its low altitude and low latitude, Australia was not necessarily a very fertile garden for the budding glaciologist, but it was a testing ground for uniformitarian principles. So the suggestion of Pleistocene glaciation

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*Transactions and Proceedings and Report of the Philosophical Society of Adelaide, South Australia* 2, 1879, 66-9; Tate, 'Elementary geology lectures'.

39 For example, see A R C Selwyn, 'Geological notes of a journey in South Australia from Cape Jervis to Mount Serle', *Parliamentary Papers of South Australia* 20 (Adelaide: Government Printer, 1859), 4; C Fenner, 'Walter Howchin 1845-1937', Obituary Notice, *Transactions of the Royal Society of South Australia*, 61, 1937, v; Tate, 'Anniversary address for the President for 1878-9', lxiv.
excited controversy.

The earliest documented identification of glacial landforms in the field was probably by the Reverend W B Clarke in the Victorian Alps in 1851-2. He recorded glacial features such as perched blocks – erratic boulders embedded in glacial till – during a geological survey commissioned by the Victorian Government. At this time, surveys of the colonies were undertaken essentially with the aim of finding gold. Most official observers recorded features of scientific as well as economic interest, but government geologists frequently expressed their distaste at being employed as 'Government Prospectors'. From the 1850s to the 1890s, a number of authors proposed that the broad valleys and plains, the lakes and the distinctively rounded hills of southern Australia resulted from the action of glaciers. This was easily refuted and other causal mechanisms were invoked to explain the landforms, such as marine inundations, subsidence, subaerial erosion and alluvial activity.

Notwithstanding the interest from distinguished metropolitan naturalists, a colonial bureaucratic preoccupation with the hunt for minerals and an early absence of government-sponsored geology probably retarded the systematic search for evidence of glaciation in Australia until the late 1860s. In 1867, in response to an article by the Roman Catholic priest Father J E Tenison Woods, the New Zealand geologist Julius Haast attempted to draw the attention of Australian geologists to the study of the physical and surface geology of the Australian Alps. Haast wanted to connect evidence of the 'glacier epoch' in Australia with that already established in New Zealand, hopefully thereby to decipher 'some of the causes by which such a

40 W B Clarke, 'Report to the Government of NSW', Parliamentary Papers of New South Wales, 1853, 37-8; idem, Researches in the Southern Goldfields of New South Wales (Sydney: Reading and Wellbank, 1860) 86, 94, 105, 117, 167, 221-34; W B Clarke to Darwin, August 1861, (Darwin Papers, DAR 161.2: 171).


42 For example, C D Aplin to W B Clarke, 9 September 1863: 'I am only a Govt. prospector & not Govt. Geologist at all', quoted in Moyal, 'A Bright and Savage Land', 126.

43 Scott, The Development of Landform Studies in Australia, 72, 89-91. For example Scott cites G S Griffiths, 'On the evidence of the glacial epoch in Victoria during post-Miocene times', Transactions of the Royal Society of Victoria 21, 1884, 7-10: 'we ought not to wonder at rock striae being scarce, but rather we might feel surprised that any should have been preserved … the smooth-swelling rock surface which tells of massive ice moving slowly across the country and planing down all prominences into flowing outlines'.

Part Two – 'Like a precious cameo'
remarkable extension … has been effected’. 44

So potentially contentious was the issue of Australian glaciation that, despite the want of convincing published evidence, Woods had spent some time refuting it in a paper presented to the Royal Society of Victoria in 1867. 45 He declared that rather than cold, 'on the contrary, we find evidence of extreme heat, or at least a heat almost tropical in South Australia', and a corresponding 'sub-tropical' fossil fauna. Woods, in turn, deplored the 'fashion' which posited the 'universality' of a period of cold from which 'even Australia is supposed not to have been exempted'. 46 Haast's gentlemanly opposition to Woods' insistence on the absence of evidence for glaciation in the Southern Hemisphere may have been influenced as much by the latter's determinedly anti-Darwinian stance as by Haast's own considerable experience of New Zealand's glaciated landscapes.

Haast's mid-nineteenth-century studies in New Zealand disturbed Woods. They compellingly suggested a much greater former extent for New Zealand glaciers during the Great Ice Age. Despite his slight reservations, Woods decided that these conditions could only have resulted from exceptional circumstances which did not apply either to Australia or to the rest of the Southern Hemisphere. 'In fact', he wrote, 'the continent is now passing through a colder period than any of which we can find evidence in its previous geological history'. 47 He rejected Joseph Hooker's assessment of 'our alpine flora' as stemming from this 'glacial period of all the world' and lamented that the prevalence of ice 'forms a prominent feature in the graceful theory of Dr Darwin and the speculations of his numerous supporters'. 48

Woods was avowedly anti-transformist. In 1876, he wrote that he 'had never had cause to entertain any doubt that we are surrounded by species clearly defined in nature, perfect in their organisation'. He concluded that 'Australian geology … can urge nothing in favour of [evolutionary theory]' despite, during two decades of

46 Woods, 'On the glacial period in Australia', 44.
researches in Australian tertiary geology, having 'carefully sought for any reasonable
evidence in favour of evolution, or clues to its mode of operation'.

His biographer Ann Player described Woods as 'leaning toward a
catastrophist rather than a uniformitarian world view'. However, this is at odds with
his rejection of a whole-earth glacial epoch, as enthusiastically endorsed by the
catastrophist Agassiz, in favour of a more Lyellian model. In any case, his
statements on the origins of caves have a decidedly gradualist bent: 'Never for ages
past enlivened by the busy hum of life’, caves 'have within themselves a wondrous
record' of the planet's changes. The cavern which 'by the small droppings of water'
has 'created itself into a palace', has 'stood silent witness to the earth's history'. While
declara

In 1867 he wrote: 'If we had no period of extreme cold in the southern
hemisphere, then the arguments or the theories which account for the glacial epoch,
on the hypothesis of changes which affected the whole earth, must be abandoned'.
This is not inconsistent with a gradualist approach to geological change, although
James Croll's gradualistic models invoked 'changes which affect the whole earth' to
reject simultaneous glaciation of both hemispheres. Woods followed with the rather

48 Woods, 'On the glacial period in Australia', 44.
51 Edward A Lane, 'J T Woods' Observations on caves, particularly those of South Australia - 1862:
cryptic claim that 'the extent to which such theories have been relied upon can hardly be credited by those who have not paid attention to the later developments of Darwin's hypothesis'.

Despite Woods' implicit criticism of 'Darwin's hypothesis', less than a year earlier Agassiz had crowed that evidence from the Amazon basin in favour of universal glaciation marked 'the end of the Darwin theory'. It could hardly be reasoned that the refutation of a 'glacial period of all the world' would be considered a set-back by Agassiz's intellectual rival. Croll had provided Darwin with a plausible solution. He allowed for the widespread contemporaneous glaciation of Eurasia and North America, but denied the possibility of a simultaneous period of cold in the southern hemisphere. His models also demanded cyclical – ie multiple – glaciation. But perhaps in 1867 Woods was not aware of the Scottish geologist's conjectures.

Much of Woods' writing on past climate change seems to consist of ad hoc hypotheses. But arguments constructed from eclectic faraway sources tend to be opportunistic and it is demanding a lot to expect consistency in a controversy that spanned more than twenty years. The problems of geographical distribution were as entangled and complex in the mid-nineteenth century as they are at the beginning of the twenty-first. The lack of any unifying doctrine encouraged both this broad-minded opportunism and equal intolerance amongst naturalists in the selection and rejection of evidence that contributed to such 'adhockery'. Janet Browne has written, of the science which came to be called biogeography, that in the mid-nineteenth century 'there was a miscellany of contemporary facts, theories, and assumptions reflecting, first and foremost, the preoccupations of the day. Distribution studies, in effect, were open to all comers'. The same might still be written of the loose affiliation of disciplines which make up the science, and is certainly true of Woods' approach to natural history.

Commonly, evidence for glaciation on mainland Australia was rejected or questioned by naturalists on the grounds that it was too localised to be reliable, and was anyway contradicted by the floral and faunal evidence. Woods based much of his analysis on faunal investigation, recent and fossil, disdaining geological observations.

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52 Woods, 'On the glacial period in Australia', 46, 47.
which appeared to contradict it: 'One or two instances of grooves or striations are recorded, but standing alone in so vast a territory the ice origin is very doubtful. On the whole, the evidence afforded by the animal remains is decidedly in favour of a warmer climate'. The evidence from plants confirmed this for Woods. Erratics were equivocal and not in situ. They could be attributed to causes other than ice, or if ice-derived, to the action of stray icebergs. So-called 'glacial' striations in bedrock were attributed to tectonic movement and doubters similarly could label 'glacial tills' as 'fault breccia'. 'Agents which polish rocks' include wallabies, tectonic movement, water, stone and 'boys with leather seats to their breeks' as well as glacier action.

Curiously, in his Geologica lObservations of 1862, Woods did appeal to glacial mechanisms to explain landforms in the Mount Lofty Ranges: 'Indeed it seemed to me that there were very distinct marks of snow, and the action of glaciers. This would declare the range to have been once of extraordinary elevation, probably the axis of some former continent'. By 1867 he rejected these mechanisms comprehensively, and as late as 1883 wrote that 'There is no satisfactory evidence of any former participation in the great ice age by the Continent of Australia'. Somewhat opportunistically given the former's change of heart, Ralph Tate in his seminal address on Hallett Cove glaciation cited Woods and his brother, J D Woods, in support of past glacier action in the Torrens Gorge.

The first reference to past glaciation in South Australia appears to be A R C Selwyn's description of a striated pavement in the Inman Valley of the southern Mount Lofty Ranges. Lacking one of their own, the South Australian Government borrowed the Victorian Government Mineralogist, Selwyn, in 1859, for a whirlwind

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54 J T Woods, 'Physical structure and geology of Australia', Proceedings of the Linnean Society of New South Wales, 7, 1883, 382. See also Woods, 'On the glacial period in Australia', 44, 45, 46: 'thousands of fossils and shells have passed through my hands [and] I am convinced that … our continent and seas have passed through a subtropical climate'; Ellery, President's address, 2-3.
55 Clarke, Researches in the Southern Goldfields, 167; W B Clarke to Darwin, August 1861 (Darwin Papers, DAR 161.2: 171).
56 Tate, 'Elementary geology lectures', 33.
59 Tate, 'Anniversary address for the President for 1878-9', lxv, lxvi.
60 D Mawson, 'Progress in knowledge of the geology of South Australia', Transactions of the Royal Society of South Australia 60, 1936, lxiii; Scott, The Development of Landform Studies in Australia, 72; Tate, 'Anniversary address of the President for 1878-9', lxiv.
survey of the colony. During this study, Selwyn discovered a smooth rock pavement with fresh-seeming parallel striations, now known, imaginatively enough, as 'Glacier Rock' or 'Selwyn's Rock'. These grooves he attributed to the action of an ancient glacier, on the basis of observations made years earlier 'in the mountain valleys of North Wales'. This was the first documented evidence for glaciation in South Australia and appeared as an inconspicuous paragraph on page four of his report.  

Despite the discovery and his interpretation of it, less than a decade later Selwyn, noting that 'The general absence of mountain lakes of any kind is a remarkable feature in the physical geography of the east Australian chain', asked whether 'this fact may not be in some degree connected with the concurrent absence of evidence, whether geological or palaeontologic, of a glacial period in Australia'.  

Pencilled on the facing page, in government field geologist Norman Taylor's notebook of 1873-75 which is interleaved with the State Library of Victoria's copy of Selwyn's book is the note 'there is slight evidence'. Taylor then listed  

One siliceous sandstone pebble from the Upper Palaeozoic conglomerate of the Mia Mia (Spring Plains) exhibits traces of groovings. – See also the last page of Daintree's Report on the Geology of the District of Ballan 1866. – Grooved pebbles on the Lerderderg River. – The pebbles of Silurian sandstone in the Lepidodendron Palaeozoic beds containing Graptolites.

Although Taylor made no mention of the Inman Valley evidence, Ralph Tate later cited Selwyn's discovery as the earliest evidence for glaciation in South Australia.

As with Woods' volte face, it is interesting, if futile, to speculate on Selwyn's reason for abandoning a glacial hypothesis. Why did Selwyn ignore evidence he had announced and published just nine years earlier? Perhaps in 1866 he wished to dissociate himself from some of the more dubious claims for recent glaciation such as

61 Selwyn, 'Geological notes of a journey in South Australia', 4.
62 A R C Selwyn and G H F Ulrich, Notes on the Physical Geography, Geology and Mineralogy of Victoria, La Trobe Collection, State Library of Victoria, Melbourne, Box 239/3, MS6216, 9; my italics.
63 N Taylor, Notebook, 1873-75, interleaved with Selwyn and Ulrich, Notes on the Physical Geography, Geology and Mineralogy of Victoria, La Trobe Collection, State Library of Victoria, Melbourne, Box 239/3, MS6216, facing page 9.
64 For example, Tate, 'Anniversary address for the President for 1878-9', lxiv; idem, 'Century of geological progress', 31.
those Woods rejected in his article of 1867. James Croll's theories were by this time two years in print. Selwyn may have subscribed to Croll's concept of secular summers and winters, which proscribed synchronous northern and southern hemisphere glacial epochs. Or perhaps he thought the evidence was too slight to draw any conclusions.

**Hallett Cove and glacial studies**

Hallett Cove came to public scientific notice when Ralph Tate, the author of our 'Retrospective Glance' and recently appointed the Elder Chair of Natural Sciences at Adelaide, announced he had found evidence of 'Late Tertiary' glaciation. In 1875 or at some time 'soon after [his] arrival in the state', he travelled 20 kilometres from Adelaide to the cove to gather sea shells and was struck by the fresh appearing 'ice-worn' rock faces and boulders on the beach. In May 1877 Tate announced his discovery at one of a series of public lectures on 'The Ancient Physical Geography and Geology of South Australia'. His presidential address to the Adelaide Philosophical Society in 1879 catapulted the issue of recent glaciation of Australia into new prominence. Incontrovertible evidence for Pleistocene glaciation, contemporaneous with the 'Diprotodon beds' of Queensland and South Australia, provided the necessary mechanism for the climate change Tate needed to explain the disappearance of the giant marsupials.

While the apparent freshness of the glacial features led him to date them to the Pliocene, which we would now term Pleistocene, their low latitude – 35° south – and low altitude – sea level – were problematic. As described in the 'Retrospective Glance', he hypothesised that elevation of the region by up to 10,000 feet during the Pleistocene and greater contemporary humidity would be sufficient for the accumulation of snow and ice into glaciers. This is consistent with his transformist views. That Tate had no mechanism for such uplift is largely irrelevant, as his major detractors had no mechanisms for the subsidence and marine inundation that they otherwise invoked to explain the features.

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65 Barry Cooper, pers. comm., 26 January 2000 suggested 1875, though other reports suggested 1877. Quote is from Tate, 'Anniversary address for the President for 1878-9', xl.

66 Tate, 'Anniversary address for the President for 1878-9', xl.

67 Tate, 'Anniversary address for the President for 1878-9', lxv-lxvi.

68 For example, Tate, 'Anniversary address for the President for 1878-9', lxvi. See also Scoular, 'The geology of the Hundred of Munno Para', 60-70; idem, 'Past climatic changes … in South Australia',
I have not found any evidence that J T Woods ever saw the Hallett Cove landforms for himself. Probably the closest he got was in February, 1878, when Tate exhibited specimens and photographs at a meeting of the Adelaide Philosophical Society of which Woods was a member. The first recorded full day public excursion to the site, with the newly formed Field Naturalists' Group of South Australia, was on New Year's Day 1884, when Woods was in Malaysia. On this occasion, nearly one hundred ladies and gentlemen 'proceeded by three coaches to Hallett Cove for a whole day excursion' where 'a lively discussion took place', with those 'well-versed in recognising the toolmarks' made by glaciers 'acquiescing with the opinion' of Professor Tate.69 When Woods returned from Malaysia he was gradually crippled by paralysis and died in 1889.70

Field experience inspired both concurrence and dissent from the eminent attendees. The first to publish his dissent was Gavin Scoular, a wealthy farmer and amateur naturalist from Smithfield, near Gawler.71 In 1879 Scoular had published a paper, extensively quoting Croll, which suggested that glaciation could not have occurred in both hemispheres simultaneously, attributed a marine origin to South Australia's 'drift'. He enlisted Lyell's ice-rafting theory to explain the erratics of Hallett Cove and other parts of the Fleurieu Peninsula. For icebergs to reach the coast of South Australia in a 'secular summer', he required a displacement of the 'frost line' by 8-10° latitude.

He dealt with the Hallett Cove evidence more specifically in a paper in 1885, following several field trips. Unlike Tate, he could not rationalise the low latitude and low altitude with an extensively glaciated landscape in the geologically recent past by appealing to uplift of the land by thousands of feet. The direction of the striations, if glacial in origin, puzzled him and he considered that bedrock weathering, aeolian activity and the erosive effects of water were more plausible agents in such a mature

36-48.

70 Player, 'Julian Tenison Woods', 108.
landscape.\textsuperscript{72} He also concluded that far from the uplift then subsidence proposed by Tate, the landscapes of South Australia showed signs of subsidence and marine inundation followed by elevation to their present height. Tate responded courteously to Scoular in the same issue of the \textit{Transactions}, submitting that the absence of marine fossils in the South Australian 'drift' argued against its marine origin, that other signs of glacier action were indisputable, and could not be attributed to icebergs.\textsuperscript{73}

Interestingly, Australian drift (called 'drift' in its general nineteenth-century sense of a superficial deposit caused by wind or water) – the sheet of aeolian sand and aggregates of clay particle that covers much of arid and semi-arid Australia, in the form of plains or dunefields – is now known as 'parna'. It is neither the result of marine inundation nor a remnant of the passage of glaciers, although it may have formed contemporaneously with the terminal Pleistocene glaciers of Europe. Australian geomorphologists consider that parna is the result of extreme aridity during Pleistocene Australia's most recent 'dirt ages', when the dunefields of the arid and semi-arid zones expanded and strong southwesterly winds swept clay and dust across the continent's inland.\textsuperscript{74}

The same year –1885 – in a highly critical synthesis of 'the literature regarding ancient glaciation of Australia', Robert Lendlmayer von Lendenfeld claimed priority for his own discoveries of glacial landforms in the Australian Alps. A physicist and geologist, Lendenfeld attributed these to a small southern hemisphere ice age around two to three thousand years ago.\textsuperscript{75} The 27-year-old German mountaineer was clearly not governed by the same laws of civility as Scoular, Tate and Woods. He stated confidently and disdainfully that 'To look for glaciers one must go up to the mountains not down to the sea'. Furthermore, the 'evidence collected by Professor Tate proves by no means that any glaciers had ever existed in Australia'. The Hallett Cove erratics 'were deposited on the beach by ice bergs stranded there'.

\begin{footnotesize}
\begin{itemize}
\item \textsuperscript{72} Scoular, 'Past climatic changes … in South Australia'.
\item \textsuperscript{73} Tate, 'Post Miocene climate'.
\item \textsuperscript{74} J M Bowler, 'Aridity in Australia: Age, origins and expression in aeolian landforms and sediments', \textit{Earth Science Reviews} 12, 1976, 279-310.
\end{itemize}
\end{footnotesize}
Finally, he imputed laziness and a lack of rudimentary glaciological sense to his esteemed colleagues: 'Every child in the European Alps knows that glaciers are formed on mountains and nowhere else'. That the 'gentlemen mentioned above never took the trouble to look' for signs of glaciers in alpine valleys indicated 'that of course no reliance whatever can be placed on their statements'.

His confidence paid off and he found 'as I anticipated, most beautiful and indubitable traces of glacial action in these valleys [of the Kosciuszko Plateau]'. However his experience of glaciated alpine landscapes did not prevent him from confusing Mount Townsend and Mount Kosciuszko. And notwithstanding his dismissive treatment of Tate's evidence for glaciation at Hallett Cove (which the German zoologist never visited), Lendenfeld assumed, in keeping with Tate's extinction hypothesis, that the Australian glacial period was pluviatile, 'with a dense vegetation in many parts of the country which are now barren, and which was sufficient to feed the gigantic Diprotodon and other fossil marsupials'.

Tate does not appear to have responded specifically to Lendenfeld's paper, but Captain F W Hutton of the New Zealand Geological Survey dismissed the latter's (and also Gavin Scoular's) claim of an iceberg rather than glacial origin for the Hallett Cove erratics. He also remarked pointedly that without having visited the locality, he could not himself judge of the evidence, 'but the iceberg theory is such a very improbable explanation of the occurrence of erratics in the latitude of Jervis Bay … that we must hesitate before accepting it as true'. He thought it more probable that Mount Kosciusco once stood some three thousand feet higher than at present, when Tasmania was joined to Australia, and Central Australia was, perhaps, a vast lake; than that the temperature of the surrounding ocean should have been reduced ten degrees without any apparent cause, which is the only alternative.

As a result of the interest in the Hallett Cove sediments, Tate became foundation

76 Lendenfeld, 'The glacial period in Australia', 45-6.
77 Scott, The Development of Landform Studies in Australia, 91.
78 Lendenfeld, 'The glacial period in Australia', 53.
79 Hutton, 'On the supposed glacial epoch in Australia', 336.
80 Hutton, 'On the supposed glacial epoch in Australia', 341.
secretary of the Australasian Glacial Evidence Committee (1888-1946) of Section C (Geology and Mineralogy) of the Australasian Association for the Advancement of Science (AAAS). He relinquished the position to Edgeworth David five years later, at the Adelaide meeting of the AAAS in 1893, when Tate was elected President of the Association. The Committee had a broad canvas in the several decades of its existence, investigating Precambrian to Pleistocene evidence. A New Zealand branch, of which Hutton was a prominent member, sprang up in 1891 to investigate extant glaciers.81

By 1887, even Tate considered the possibility – albeit dismissively – that his glaciation might be earlier than Pleistocene.82 In 1893 the fifth meeting of the AAAS was held in Adelaide. Delivering the inaugural address to members of the Association on 26 September, Tate claimed triumphantly – and precipitately – that although there have been [geologists] who have opposed and even ridiculed the notion of glaciation in such low latitudes and at such inconsiderable elevations … today we may congratulate ourselves that a Post-Miocene glacial period occupies an unassailable place in the geological history of Australia. Mr Jack [of the Queensland Geological Survey] has lately added his testimony, as the result of personal inspection, that "Prof. Tate's observations are correct in every particular" … This expression of opinion by a master in the art of interpreting glacial signs will, I am sure, carry conviction to the minds of those who till now have been sceptical.83

The *Adelaide Observer* reported the lecture, 'A century of geological progress in Australia', the following Saturday.84

The same day, Tate led 'the largest field trip ever held in the Southern Hemisphere' to the cove, when on Saturday morning, '150 ladies and gentlemen took

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81 Joyce, pers. comm. 23 February 2000. Much of the work of the Australasian Glacial Evidence Committee was taken over by the Cainozoic and Quaternary Climate Committee during the 1920s.
82 R L Tate, 'Glacial phenomena in South Australia', *Report of the first meeting of the Australasian Association for the Advancement of Science*, Sydney, 1887, 231.
83 Tate, 'Century of geological progress', 31.
84 Anon., 'Report of the President's address to the fifth meeting of the Australasian Association for the Advancement of Science', *Adelaide Observer*, 30 September 1893, 15.
their places on six drags and a wagonette for the contemplated outing' at ten o'clock.85
A detailed, well-informed, if celebratory, report of the excursion was published in the
Observer of 7 October. Among the learned party was Sir James Hector, Director
General of the Geological Survey of New Zealand, who was keenly interested in
glacial studies. On this occasion the Methodist minister and geologist, Walter
Howchin, first encountered the features.

'relics of a far more ancient glaciation'
As Tate had predicted, questions as to their glacial origin were here put to rest:86
'There was present before them the path of an extinct glacier, on the course of which
they were standing, and which could be traced in an almost unbroken line for a
distance of two miles along the cliffs'.87 To the south and west of the party lay the
ocean, to the east, stretching northward lay the Mount Lofty Ranges. Hence the
'physical features of the country were such as to suggest that the ice was most likely
to travel from the north in a southerly direction'. But the ground was examined and
Tate explained his conclusions: 'a careful examination of the way in which the ice
had planed the rocks over which it moved' showed that 'its passage must have been
from south to north', so 'we must assume that in the time of glaciation the high land
was to the southward'.88 Indeed, in the absence of a model such as plate tectonic
theory to suggest the lateral movement of continents, these or similar conclusions
could hardly be avoided. The putative 'high land' also accounted for the presence of
permanent snow at such low altitude and latitude and conveniently matched Tate's
hypothesis of post-glacial loss of climatic equability due to the depression of a
peneplain.89 But it was also at this singular event that questions were raised about the

86 Tate predicted that on viewing the Hallett Cove features, glaciologically-informed scientists could
not fail to be convinced of their origins in Anon., 'Report of the President's address to the fifth
meeting', 15, and Tate, 'Century of geological progress', 31. General acceptance of their glacigenic
nature is acknowledged in Howchin, 'New facts … Hallett's Cove', 61. See also T W E David,
'Evidences of glacial action in Australia and Tasmania', Report of the sixth meeting of the Australasian
Association for the Advancement of Science, Brisbane, 1895, 58: 'To-day … if any geologist were to
question the glacial origin of the pavement at Hallett Cove, he would be looked upon by his fellows as
da dangerous lunatic. Thus has the whirligig of time brought in revenges to the old prophets'.
87 Anon., 'Report of a field trip to Hallett's Cove', 43.
88 Anon., 'Report of a field trip to Hallett's Cove', 43.
89 Tate, 'Anniversary address for the President for 1878-9', lxvi-lxvii.
Pleistocene age of the sediments.\textsuperscript{90} Doubt stemmed from their stratigraphic position in relation to the thin band of fossiliferous sandstone described in Panel 6 of Chapter Four, identified by Tate as 'Miocene', and referred in conventional modern geological histories to an early Pliocene sea:

The point of greatest interest raised on this classic ground was the period at which this age of ice occurred in our neighbourhood. It has been generally assumed that the period was one later than the times when the adjoining miocene beds were deposited. Sir James Hector expressed his strong conviction that it was older than that, and was probably cretaceous, which would make it synchronous with similar glacial evidences in Australia, and with similar deposits in New Zealand.\textsuperscript{91}

Examination in the field that day proved unhelpful, and the Council of the Association determined to set aside £20 for the purpose of determining the age of the Hallett Cove deposits. Tate, Howchin and David were duly appointed.\textsuperscript{92} They dug a number of trenches and eventually established that the glacial sediments were overlain by the 'Miocene' marl, proving the greater age of the former. Their findings were jointly published in 1895.\textsuperscript{93} David and Howchin hypothesised a link with glacigenic features from Bacchus Marsh dated to the Permo-Carboniferous.\textsuperscript{94} Tate, perhaps protective of his intellectual legacy, seemed less willing than either of the other men to assign the older date: 'The fact that the glacier-path at Hallett's Cove is pre-Miocene should not force us to accept contemporaneity with the glacier-phenomena at Bacchus Marsh, admittedly of Permo-Carboniferous age, which there seems a too-hasty disposition to concede'. In support of an alternative, 'the stratified rocks of New South Wales and New Zealand' indicated other, later glacial periods in

\textsuperscript{90} Howchin, 'New facts … Hallett's Cove', 61-2.
\textsuperscript{91} Anon., 'Report of a field trip to Hallett's Cove', 43.
\textsuperscript{92} Howchin, 'New facts … Hallett's Cove', 62.
\textsuperscript{93} R L Tate, W Howchin and T W E David, 'Report to the Research Committee appointed to collect evidence as to glacial action in Australasia: Evidences of glaciation at Hallett's Cove', \textit{Report of the Sixth Meeting of the Australasian Association for the Advancement of Science}, Brisbane, 1895, 315-20.
\textsuperscript{94} Tate et al, 'Evidences of glaciation at Hallett's Cove', 318.
the stratigraphic record.95

At the Brisbane meeting of the AAAS, David in his presidential address to Section C stated that some of the glacial features of Hallett Cove were probably the work of Antarctic icebergs, and that the glacial beds were all of marine origin.96 Howchin was quick to discount this in a paper delivered to the Royal Society of South Australia and reported in the *South Australian Register* in April 1895:

I had not the privilege of hearing the Professor's address at the Brisbane meeting, and am consequently quite ignorant of the evidences he may have at command ... but ... I must respectfully hesitate in accepting Professor David's conclusions as to the source of the ice. I cannot see how berg ice could polish and grove [sic] hard rocks over extensive areas, whilst maintaining definite lines of erosion and striae, such as we have at Hallett's Cove. I am led to think there is nothing but terrestrial ice, of great thickness, and operating through a long period, that could produce effects such as we have referred to.97

The account above of Howchin's paper as delivered to the Royal Society on 3 April and published in the *Register* three days later differs from the version published in the Society's *Transactions*, in that the latter forbore to mention David by name and also stated the case against icebergs more strongly:

In view of the extremely low latitude of Hallett's Cove ... we might have fallen back on the iceberg theory if the features had been reconcilable with such an hypothesis. This, however, is inadmissible.98

Howchin went on to correlate the features with glaciogene sediments from Bacchus Marsh, dated to the Permo-Carboniferous. They are generally now accepted as being of early Permian or late Carboniferous age, and predominantly of terrestrial, rather

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95 Tate, 'Anniversary Address of the President for 1894-95', 276.
96 Anon., 'Glacial features of Hallett's Cove', report of a paper read by W Howchin to the Royal Society of South Australia, 3 April 1895, *South Australian Register*, 6 April 1895, 58; David, 'Evidences of glacial action in Australia and Tasmania', 82, 84-8, 92, 94-5; Tate et al, 'Evidences of glaciation at Hallett's Cove'.
98 Howchin, 'New facts ... Hallett's Cove', 69.
than marine, origin.99

Far from disappointing, the confirmation of a pre-'Miocene' date for the Hallett Cove glaciation and its correlation with the probable Permo-Carboniferous features at Bacchus Marsh, in southern India, and southern Africa excited most commentators. David wrote in 1895 that 'important as have been the evidences discovered by those who have studied the marks of Pliocene or Post-Pliocene glaciation in Australia and Tasmania, they are dwarfed when placed beside the gigantic relics of a far more ancient glaciation, the true nature of which has been fully recognised only within [a] very recent date'.100

Ralph Tate published no more on Hallett Cove after 1895, though he continued to read widely and lecture on glaciation until his death six years later, and by the late 1890s he seems reluctantly to have accepted the Permo-Carboniferous date.101 His colleague and former student, Herbert Basedow, took up the cause after Tate's death and continued to plague Howchin for some years, with Howchin commenting at the 1907 Adelaide meeting of the AAAS that 'Mr Basedow practically stands alone in the way in which he has read the rocks'.102

It seems Hallett Cove was the making of Walter Howchin. A Primitive Methodist minister, he came to South Australia from England in 1881 aged 36, for the sake of his declining health. He remained a devout Methodist and combined his itinerant preaching with opportunistic fieldwork and teaching about evolution:

By interviews and by a laborious correspondence … he implanted


100 David, 'Evidences of glacial action in Australia and Tasmania', 58.

101 See revisions to Tate, 'Elementary geology lectures', vol. 1.

in many hearts the love of God revealed in Nature … It is well known that he took an active part in the reconciliation of Science and Religion, and in the controversies of the last generation on Genesis and Geology, he was a sympathetic exponent of the views that have prevailed. He was not a bitter partisan, but a persuasive expositor of science.\textsuperscript{103}

He was lecturer in Geology and Palaeontology at the University of Adelaide from 1904, as Tate’s replacement, until 1920. He continued to publish widely on both glaciation and matters palaeontological, practising as a field geologist until his death in November 1937, aged 92, of complications resulting from heat-stroke incurred while working in St Vincent Gulf during a heat-wave.\textsuperscript{104}

Howchin’s pioneering work at Sturt Gorge on an earlier Precambrian glaciation is an important part of the Hallett Cove story as well.\textsuperscript{105} The Permian glacier that scored and blanketed and froze the Carboniferous palaeo-valley at Hallett Cove carried with it boulders of Sturtian tillite ripped from the walls of Sturt Gorge, formed 400 million years earlier, during what has been described as the most severe ice age in earth history.\textsuperscript{106} Yet another felicitous conjunction of former landscapes is revealed as ‘below the disassembling world lie the ruins of a disassembled world, below which lie the ruins of still another world’.\textsuperscript{107}

This leads us to the modern geological era. As Maud McBriar, Patron of the Field Geology Club of South Australia, wrote in a recent University of Adelaide
publication, 'Nothing untoward happened to this quiet spot, then undeveloped, on the rocky coast of Gulf St Vincent' for over half a century. 'And who would ever think of damaging such an esteemed geological site?' 108

Chapter VI

The battle for Hallett Cove

Informed by a geological aesthetic and by the history of their discipline, Hallett Cove has been a significant site for South Australian earth scientists almost since its scientific discovery in 1875, both for the 'geological heritage’ which it embodies and for its physical geography. Because of its emblematic status and its apparent isolation, as Maud McBriar declared above, it was not immediately obvious to most geologists that the site would need protection from the 'tentacles' of urban sprawl.1 Developers, on the other hand, failed to appreciate any 'beauty' that could not be improved by sensitive urban planning, subdivision and landscaping in such an expanse of soaring land values. The seventeen year campaign to preserve the geological integrity of Hallett Cove may have helped to effect an appreciation and awareness of geology, deep time and natural heritage in South Australians. But contrary to the sometimes triumphalist rhetoric of the anti-development campaigners, it is not an innate specialness that made the cove news-worthy or salvageable. Rather, a complex interplay of events influenced the course of the campaign to help the Geological Society and the National Trust secure popular support to save a landscape that in the eyes of many could have been any other.

South Australian parochialism and the trope of 'uniqueness' helped mobilise public opinion against the developers. At least two of the companies planning to subdivide Hallett Cove during the 1968-1975 period were West Australian (Kadima Pty Ltd. and Silesia Pty Ltd.). This was belaboured in the media. Public and media demands for accountability, the buzz-phrases 'ecology', 'national estate' and 'urban sprawl', the rapid advocacy of the cove by establishment bodies with clout during the early stages of the campaign, the effective mobilisation of the romance of 'deep time' in the reconstruction of Hallett Cove's interlocking constellation of theme park landscapes, all these contributed to the eventual reservation of fifty hectares of cove land in 1976. It is impossible to say whether campaigners tapped the zeitgeist or the

1 But see an article by H A Lindsay ('Ancient treasure in reserve', Advertiser [Adelaide], 22 November 1965, 1) for the assertion that 'On numerous occasions, the late Sir Douglas Mawson, who died in 1958, and other geologists advocated that the Government should take steps to preserve the glacial pavement. Botanists added their pleas, stating that on the area some interesting native plants were surviving which appeared to be extinct elsewhere. Nothing was done however'.
zeitgeist caught up. But the resonance between the deep past as represented by its material remains at Hallett Cove and the concept of 'natural heritage' as part of a 'National Estate' captured media and eventually bureaucratic imaginations and continues to play an important part in the articulation of philosophies of geological heritage, conservation and site management in the state.

**Threat of development**

In the late 1950s, the location of the cove, thirty kilometres south of the centre of an expanding metropolis, led to the threat of subdivision and the destruction or burial of the 'historic' glacial pavement and other features considered important in the story of the assembling of South Australia. On the 1962 State Development Plan (*Report on the Plan for the Metropolitan Area of Adelaide*) the land was re-zoned from rural to residential which made the issue of its protection ever more pressing.\(^2\) A series of 'battles' was fought across three decades between developers and groups interested in preserving the geology of Hallett Cove. This dispute loosely divides into three phases, the first from 1957-1965, the second from 1965-1969 and the third from 1971-1976, to be discussed in more detail in the next section.

In 1957 the National Trust of South Australia began negotiations to preserve a small 'representative' strip of coast including 'Tate's' striated pavement, which culminated in the dedication of the Sandison Reserve in 1965. From 1965, Maud McBriar and other staff at the University of Adelaide, particularly from the Geology, Botany and Zoology departments, members of the Geological Society and the Nature Preservation Committee of the National Trust of South Australia, mobilised an eclectic and formidable array of Australian and international scholars, students, heritage bodies, politicians, school teachers, naturalists and local communities to oppose successive attempts to subdivide and 'develop' the cove.\(^3\)

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\(^2\) Caldicott and Geering, 'Development and disaster', 20; J Sibly et al, 'Planning for Hallett Cove: A report', unpublished report by the Adelaide College of Adult Education commissioned by the Corporation of the City of Marion, 1975 (*Hallett Cove Papers*), 3. Although Hallett Cove was not distinguished for protection, preservation or 'special treatment' of any kind, 'No formal objection was raised concerning the zoning of Hallett Cove as a residential area' because it was the first planning report of this type and 'the public had little appreciation of its implications'. ([Toteff], *Hallett Cove Conservation Park*, 14)

\(^3\) Anon., 'Buffer area needed', *Advertiser* (Adelaide), 16 September 1971, 1; T S Martin and Associates, 'Hallett Cove development application', unpublished report prepared for Kadima Pty Ltd and Silesia Pty Ltd, Perth, August 1971 (*Hallett Cove Papers*), 1; S Cockburn, 'Another threat for Hallett Cove', *Advertiser* (Adelaide), 16 September 1971, 1; idem, "Not detrimental", *Advertiser* (Adelaide), 16 September 1971, 1; C Hamilton, 'Subdividing Halletts Cove', unpublished Environmental Law seminar
In 1969 they succeeded in gaining limited protection for fifty-one acres of
cove land. This area was reserved as a 'Site of Scientific Interest'. Under new South
Australian Government legislation, it remained the property of the Kadima and
Silesia Development Companies. The companies had purchased the land from K J
Powell early in 1969 after reservation had been mooted in 1967.4

In 1971, the campaigners demanded 'Major Open Space' legislation
recognising Hallett Cove as an 'outdoor laboratory' and 'museum'.5 This depended
upon State Government purchase and expansion of the Site of Scientific Interest to
include a buffer zone. In 1972 the State Government, 'prompted by overwhelming
public concern' and acting 'to what is believed to be the limits of its financial
resources', acquired 118 acres of land adjacent to the Sandison Reserve.6

Further campaigning between 1972 and 1975 eventually secured Federal
Government intervention. Under the recently established National Estate Program,
the Federal Minister for Urban and Regional Development, Tom Uren, commissioned
an investigation of the 'scientific, environmental and social issues relating to urban
development' at Hallett Cove, known as the Rudman Report.7 With subdivisions
pressing upon its hems, a conservation park of approximately 50 hectares was
gazetted on 1 July 1976, to the qualified satisfaction of the groups and individuals
concerned with the cove's 'preservation'.8

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4 South Australian Planning and Development Act 1966-67, sections 36-38. For detail see also
unpublished paper on environmental law at Hallett Cove by Hamilton ('Subdividing Halletts Cove', 2-
5) and the Kadima and Silesia development companies' 'Hallett Cove development application' (T S
Martin and Associates, 'Hallett Cove development application').

5 For example, anon., "Relax" is a foreign word', News (Adelaide), 20 September 1971; [Toteff],
Hallett Cove Conservation Park, 14; Warburton and McBriar, 'The Hallett Cove affair', Issue: A Journal of Comment, October 1975, Department of
Adult Education, University of Adelaide, 4.

6 Quotes from [Toteff], Hallett Cove Conservation Park, xv; C W Bonython, G W Toogood, E M
McBriar, J M Thomas, 'Submission to committee appointed by the Australian government to enquire
into the preservation of Hallett Cove', unpublished report, National Trust of South Australia, May
1975 (Hallett Cove Papers), np; R Ellis and G Warnes, 'Hallett Cove Conservation Park, an
environmental resource', unpublished student report, Sturt CAE, Environmental Studies, 1977 (Hallett
Cove Papers), 5; Warburton and McBriar, 'The Hallett Cove affair', 5.

7 P Rudman, et al, 'Hallett Cove study report: An investigation of the scientific, environmental and
social issues relating to urban development in the Hallett Cove area', Commissioned under the
National Estate Program, for the Minister for Urban and Regional Development, Mr Tom Uren,
Canberra (Hallett Cove Papers). (Henceforth, 'Rudman Report')

8 NPWS, 'Hallett Cove Conservation Park'.
Changing priorities in natural heritage management

The terms of the debate shifted as the voices of conservation and preservation gained cohesion and confidence throughout the 1960s and 1970s. Among other factors, the campaigners' escalating demands for land to be reserved reflected a new articulation of notions of natural heritage and national estate, a changing demographic and consequently shifting priorities within the heritage movement nationally and an increased demand for public land, public consultation and bureaucratic accountability.9

In 1957, the National Trust sought to preserve only a small section of land – the striated pavement known as Tate's Rock – the importance of which lay in its perceived embodiment of a moment in the intellectual history of South Australia, when Tate discovered signs of its past glaciation.10 Between 1965 and 1969, the National Trust, Geological Society and other interested organisations campaigned for the preservation of another relatively small piece of land adjacent to the Sandison Reserve, 51.25 acres, barely half the recommended area.11 In 1975, Warren Bonython, G W Toogood, Maud McBriar and Ifor Thomas retrospectively explained the trust's policy in a submission to the Rudman Committee of Enquiry:12

Since 1965, when the 12 acre Sandison Reserve was vested in the trust, this organisation has co-operated with others in an attempt to expand the reserve in order to protect more fully and adequately

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9 See Tim Bonyhady, 'The stuff of heritage', in Prehistory to Politics: John Mulvaney, the Humanities and the Public Intellectual, eds T Bonyhady and T Griffiths (Melbourne: Melbourne University Press, 1996), 145. "National estate" and "heritage" are two such keywords ... The clear implication in each is that the public interest in environmental protection should take precedence over established private rights, or for that matter competing public interests'. Libby Robin ('Nature conservation as a national concern: The role of the Australian Academy of Science', Historical Records of Australian Science 10(1), 1994, 1-24; idem, 'Radical ecology and conservation science: An Australian perspective', Environment and History, 4(2), 1998, 199-202) explained the process by which scientific expertise was decentralised during the 1960s, in the shift from the campaigns of the 1950s which 'established the right of scientists to speak on behalf of nature', to 'radical ecology', with its demands for 'cultural and aesthetic arguments, as well as democratic participation' in conservation debates, which has seen the marginalisation of some scientific ecologists.

10 Bonython, 'Our role in conserving Hallett Cove', 3; Bonython, pers. comm., 22 March 2001; Clarke, 'Hallett Cove ... notes on preservation', 3.

11 Bonython, 'Our role in conserving Hallett Cove', 3; Bonython et al, 'Submission to committee appointed ... to enquire into the preservation of Hallett Cove', np; Caldicott and Geering, 'Development and disaster', 20, 1975, 113; Maud McBriar, pers. comm., 21 March 2001.

12 In their capacities, respectively, as President, Director, Chairman of the Nature Preservation Committee and Member and past Chairman of Nature Preservation Committee, of the National Trust of South Australia.
the scientific phenomena which occur at Hallett Cove, and to preserve the natural aspect of the area.

They pointed out that 'from the beginning', the trust believed that 'any land which could be added to the Sandison Reserve would have to be acquired by purchase, eventually'. So, given its limited financial resources, the organisation 'realistically supported schemes which proposed minimal extension of the boundaries to conserve the most important of the scientific features'. Accordingly, decisions on boundaries 'were frequently determined by economics and by the tactics of settling questions with one land owner at a time'. In defence of the policy, they wrote that 'gains were made' using their 'pragmatic approach'.

But in the early 1970s, in conjunction with a number of other organisations and individuals and in the wake of public and media outrage at perceptions of the developers' intransigence, greed and double-dealing, and imputations of local government opacity, incompetence, corruption and high-handedness, it threw such caution to the winds. It demanded the State Government intervene to prevent further damage to the site of scientific interest and to 'significant' geological, archaeological and historical features which fell outside its boundaries.

Preserving the 'broad panorama'

This shift in policy roughly coincided with practical changes in the way in which Hallett Cove was studied and valued by geologists, associated with the untangling of plate tectonics, as articulated by Maud McBriar on behalf of the Geological Society in 1975:

For explanations of geological concepts of an ancient ice-covered land mass with glaciers coming down to the sea, continental drift and plate tectonics, a broad panorama is desirable. This will be

13 Bonython et al, 'Submission to committee appointed … to enquire into the preservation of Hallett Cove', np.

14 For example, Caldicott and Geering, 'Development and disaster'; SASTA, 'Hallett Cove today'; anon., 'Conservation and the Cove', Editorial, Advertiser (Adelaide), 15 September 1971, 2; Flyer authorised by the Adelaide Marxist-Leninists, 1971, 'The facts about Hallett Cove' (Hallett Cove Papers): 'This whole affair is a perfect example of how monopoly capitalism operates in our society. Big Business (eg ANZ Bank) manipulates our so called democratically elected representative (eg Marion Council, which is, incidentally, predominantly Labor) in order to derive the greatest possible profits … Obviously it is not the wishes of the majority of the people which determines the fate of our environment, or infact [sic], any other matter in society, but the profit-seeking interests of Big Business'.

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The shift in emphasis in geology from an earlier interest, primarily in an ancient glacier, to the modern concern with wider aspects has led geologists to realise that more than a few acres of reserve is needed to preserve and to demonstrate the totality of the geology exposed here.15

Hamstrung by lack of funds and unfavourable legislation the trust nonetheless continued to press government and attempt to engage public interest.16 It was 'gratified' when the South Australian Government acquired 118 acres of cove land for a reserve in 1972 and 1973, although this 'fell short of the desired area'.17 The success of the campaign perhaps echoes that of the Victorian Little Desert campaign of 1968-71, itself illustrative of a paradigmatic shift in the awareness of places worth saving in that state.

The trust's change of policy also reflected the need for public space outside the reserve, in the form of a 'buffer zone', to protect the features as much as possible from idle curiosity, recreation, 'rockhounds, gardeners, and boatowners' and excessive 'trampling'.18

Dr Ron Caldicott, the Director of Research, Town and Country Planning Association of South Australia, was also an Executive Member of the Australian Conservation Foundation. In a number of articles written and statements made between 1971 and 1975, he harnessed awareness of this need for 'Major Open Space' legislation, both for improved quality of urban life and to protect the conservation park:

a major district open space should be declared … bounded by the railway on the east, the Hallett Cove road on the south, and the existing development at the northern edge … The buffer zone created by … this open space would have taken the impact of people off the beach and thus the scientific areas would be

16 Bonython et al, 'Submission to committee appointed … to enquire into the preservation of Hallett Cove', np.
17 Bonython et al, 'Submission to committee appointed … to enquire into the preservation of Hallett Cove', np.
18 Caldicott and Geering, 'Operation Hallett', 113.
protected. Undoubtedly, the recreational effects of a community of thousands of people would inevitably destroy an irreplaceable asset … the impact … on such an area of real scientific and historical significance will be disastrous … regardless of what efforts can be made to protect the reserve by the National Trust or any other body. … attention should have been given to the needs of society as a whole as well as those of the subdividers. The atmosphere of Hallett Cove has been lost forever. We will have suburbia, with minimum size allotments near Hallett Cove which will never be the same.19

By 1975 the trust's earlier more conservative policy was perhaps seen as naive. In support of 'many conservationists and other bodies in this State', it demanded that the boundaries of the Hallett Cove reserve be extended to the railway line to the east and Grand Central Avenue to the south. In its role championing 'causes such as this which will assist in the preservation of the national heritage', it understood the action at Hallett Cove to be 'the last opportunity to act before the land is settled with houses and beyond redemption':

This is an area which is priceless in terms of its geological contents and, if destroyed or further seriously mutilated, would spell the end to the effective presentation of processes that have taken more than 600 million years to be created. The trust strongly advocates protection of the total area described in this submission.20

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19 Caldicott and Geering, 'Development and disaster', 22. For some other references to proposed 'Major Open Space' legislation and calls for a large public reserve in the area to remove pressure from the conservation park see Anon., 'Developer alters Hallett Cove plan'; anon., 'Cove protest meeting call: MP urges wider scheme', News (Adelaide), 20 September 1971, 2; anon., 'Govt. supports cove buffer', Advertiser (Adelaide), 21 September 1971, 3; Bonython et al, 'Submission to committee appointed … to enquire into the preservation of Hallett Cove', np; Caldicott and Geering, 'Operation Hallet', 113; Conservation Council of South Australia, 'Urgent – save Hallett Cove', Advertisement inserted on behalf of the Save Hallett Cove Committee, Advertiser (Adelaide), 2 April 1975; N Horr, 'Preserving heritage', Letter to the Editor, Advertiser (Adelaide), 22 September 1971; Rudman Report; SASTA, 'The need for the Government to acquire … Major District Open Space'.

20 Bonython et al, 'Submission to committee appointed … to enquire into the preservation of Hallett Cove', np.
Three steps to salvation

1957-1965: Professor Alderman writes to the National Trust which spends eight years negotiating with a recalcitrant local council to preserve 'a few scratches'

Arthur Richard Alderman, Chair of Geology and Mineralogy at the University of Adelaide, made initial moves to protect some of the cove in 1957. He approached Marion Council, who advised him to seek out the relevant landowner, George Sandison, and suggested that he 'report to the National Trust that there are many places of geographical interest in Halletts Cove, with the object in view of the National Trust taking over some portion of Halletts Cove property as a Public reserve'. 21

On 5 April, he sent a letter to the newly formed Nature Preservation Committee of the National Trust of South Australia. The Secretary, H G C Kempe, and the Chairman, Norman Tindale, inspected the Hallett Cove land on 5 August and 29 August 1957 on behalf of the Committee, which then commenced negotiations with George Sandison. Sandison agreed in principle to donate three hectares of land to the National Trust, containing 'Tate's Rock', supposedly the polished and striated pavement that Tate identified, but he died in 1958 well before negotiations were complete. This slowed proceedings, as the trust then had to negotiate with Elders Trustee and Executor Company Ltd, acting on behalf of Sandison's thirty beneficiaries.

Initial investigation by Elders Trustee revealed that there was a surveyed but impracticable government road along the whole sea frontage of Sandison's land, and that it was impossible to identify the boundary between the Sandison Estate and government land. In 1959 the Minister of Roads informed the trust that a survey would be necessary to 'establish if the pavements [were] on the road reserve', and that the land was vested in the Corporation of Marion, which should be able to indicate both the actual location of the pavements in relation to Sandison's land and whether there was to be a road constructed in the area.

On meeting with Nature Preservation Committee members C Warren Bonython and Jeffrey Clarke in April, representatives of the Marion Corporation stated that there was no road along the cliff top as indicated by the Minister of Roads,

21 Clarke, 'Hallett Cove … notes on preservation', 1.
and that the glacial pavements were within the 150 links coastal reserve and therefore in the South Australian Harbours Board property. They informed the trust that the corporation had no jurisdiction in the matter. However in June of that year, a survey of the area was carried out which indicated that the Minister's statement regarding the existence of a road, under control of the Marion Corporation, was correct.

In November 1959, Elders Trustee informed the trust that Sandison's beneficiaries had agreed to donate a strip of land one chain wide alongside the segment of surveyed road containing the glacial pavement, to be called the 'Sandison Reserve'. This was despite strong recommendations by Professors Alderman and Rudd and Dr A W Kleeman, all of the University of Adelaide, that a far larger area should be preserved. In keeping with the policy outlined previously, Bonython and other members of the Nature Preservation Committee were afraid that if they requested more, they might prejudice the trust's chances of acquiring any of the land.\footnote{Bonython, pers. comm., 22 March 2001; Clarke, 'Hallett Cove … notes on preservation', 3.}

Negotiations with the City of Marion Council continued over the next five years as the trust endeavoured to obtain the strip of road abutting the reserve, on the cliff-top above the beach and tidal flat. Meanwhile Marion Council attempted to force the trust to negotiate on the council's behalf with Sandison's beneficiaries, to encourage the latter to donate to the council an equivalent portion of land to that requested by the trust. For example, Clarke noted that at a meeting on 14 December 1959, the council 'decided that it approves of the [closure of the] roadway along the coast at Halletts Cove' provided that 'a similar strip of land to the east in lieu thereof is made available for roadmaking purposes'. In further consultation with Marion Council it was made clear that it was up to the trust to approach Sandison's beneficiaries for additional land for the substitute road.\footnote{Clarke, 'Hallett Cove … notes on preservation', 4. The trust was notified on 7 January 1960.} This included the unsubstantiated threat that the State Government was considering the construction of a 'Coast Road' or marine drive 'within the next twelve months' which would cut across the unprotected glacigenic sediments and features and seriously compromise the Sandison Reserve.\footnote{Clarke, 'Hallett Cove … notes on preservation', 5.} In response, the trust informed the council in January 1960 that it would not ask the Sandison Estate for more land, and that it was 'financially

\footnote{Clarke, 'Hallett Cove … notes on preservation', 5.}
and practically impossible' to construct the road along the present survey.\textsuperscript{25}

Deputations were made to the Minister of Roads and to the Marion Council as prominent members of the University of Adelaide Geology Department, the Royal Geographical Society, the Geological Society of Australia (SA Division), the Royal Society of South Australia and the National Trust continued to press for the closure of the road. On 10 October 1962 the council advised that approval had been given. Further delay transpired when Ruby Rachael Coombs, owner of 'The Leys' which bordered the road, objected to its closure on the grounds that 'she thought the area was most uninteresting'.

The reserve was expanded to 5.5 hectares in 1965 when the Lands Titles Office transferred the title from the Marion Council to the National Trust. Its official opening was held on 20 November.\textsuperscript{26} The Secretary of the Nature Preservation Committee during the greater part of the negotiations, Jeffrey Clarke, attributed the five year delay to 'continued procrastination by the Marion Councillors and Council officials', who, like Miss Coombs, may have failed to see the worth of a few scratches on a windswept pavement atop a scrubby cliff. Meanwhile, the Field Naturalists' Society of South Australia had been lobbying the National Trust since mid-1960 for protection for land bordering the Amphitheatre south of Black Rock, owned by Woodend Park Ltd. Following the successful acquisition of the Sandison Reserve, the trust's attention turned to this matter.\textsuperscript{27}

1965-1969: Maud McBriar challenges the powers of monopoly capitalism at Hallett Cove and strikes a blow for geology

McBriar has said that a major element that emerged from the 'Save Hallett Cove' campaigns was a growing awareness from geologists that they could not afford to be

\textsuperscript{25} Clarke, 'Hallett Cove … notes on preservation', 6: 'The proposed construction of a road along the clifftop by the Marion Council is hardly practical … The Surveyed Road actually overhangs the cliff in front of section 566 and it would be completely impossible to construct a road along this section of the survey unless unlimited funds were available and the road was built on piles from the base of the cliff. It would thus appear that it is not economic to use the existing surveyed road and if a road were contemplated additional land would have to be acquired by the Marion Council. Under these circumstances it is felt that the closing of the road would cause little or no inconvenience to the Council and certainly no extra cost'. Also Lindsay, 'Ancient treasure in reserve', 1: 'the map shows that one-half of it was on the cliff-tops but the other half out in the air, at up to 100 feet above a boulder-strewn beach below'.

\textsuperscript{26} Clarke, 'Hallett Cove … notes on preservation', 11; Lindsay, 'Ancient treasure in reserve', 1.

\textsuperscript{27} Clarke, 'Hallett Cove … notes on preservation', 13.
complacent about matters and sites of geological heritage.\textsuperscript{28} Without an educated public, the value and interest of many geological sites is far from clear. One woman's historic glacial pavement is another woman's 'most uninteresting' beach frontage.

In 1965, McBriar was a senior demonstrator in the Geology Department at the University of Adelaide. She taught an extra-mural course to regional planning students at the South Australian Institute of Technology (SAIT). At her suggestion, they began a project on Hallett Cove and came to her with the 'alarming news' that a dense housing subdivision had been drawn up for land bordering the newly dedicated Sandison Reserve. This would 'destroy' the geology of the coastal hinterland that was 'fundamental' to the geological story of the area.\textsuperscript{29} They wrote a report proposing a one hundred acre Conservation Park to preserve areas of historic and scientific interest.\textsuperscript{30} Upon request from Mr Henry Parsons, Senior Lecturer in Planning and Landscape, the Head of the School of Architecture and Building at SAIT, Gavin Walkley granted permission for its widespread circulation.\textsuperscript{31}

McBriar's involvement continued when Ifor Thomas, a zoologist at the University of Adelaide and acting Chairman of the Nature Preservation Committee of the National Trust, asked for her help and invited her to attend a 'viewing' of 'the terrain with the object of delimiting as far as possible what needs to be preserved' on 2 September 1966.\textsuperscript{32} Those in attendance included Thomas, McBriar, two other members of the National Trust, including Charles Alexander who was there in his capacity as representative of his firm of surveyors, who had prepared subdivision plans for the potential buyer (K J Powell), the Director of Planning at the State Planning Office, Stuart Hart, and Professor Martin Glaessner of the University of Adelaide as 'an expert witness on geology'. Neither Powell, who eventually


\textsuperscript{29} McBriar, 'The protection of Hallett Cove'.


\textsuperscript{31} Maud McBriar, pers. comm., 12 February 2002. See letter from Graham Whitten, Chairman, GSA, SA Division and chief geologist, Department of Mines, SA, forwarded to R W Neshitt, Secretary, 12 July 1966: attached, map of SAIT student proposal and distribution list and list of over twenty replies (Hallett Cove Papers). This included responses from F H Walsh, Premier of SA; Don Dunstan, then Attorney General; and Sir Thomas Playford, leader of the Opposition.

\textsuperscript{32} Ifor Thomas to E M McBriar, 17 August [1966].
Eighty acres of the land fell within the property of one landowner (Powell) 'and covered most of the geological features' and twenty acres to the south were the property of another owner (Sheidow). Continuing the policy of the Nature Preservation Committee during the Sandison negotiations, the National Trust and associated bodies again asked for considerably less land than they considered necessary fully to protect the areas of geological, archaeological and historical interest. They justified this pragmatically, on the basis that the land belonging to Powell was threatened more immediately by subdivision and that fifty acres of this 'was the absolute minimum area for the preservation of the essential geology and of one of the more important of the aboriginal campsite areas'. Negotiations were made simpler for involving only one landowner. Economic reasons also governed the decision, as the trust feared that it or a similarly cash-strapped organisation would need to purchase the land to ensure its preservation and Powell had valued the twenty-five acres of 'greatest' geological significance at $250,000 in 1967. Then president of the trust, Dean Berry, pointed out that 'this can only be regarded as a gross over-estimate of its real value either for land development or for its mineral potential'. But the trust was in the invidious position of trying to put a price on perpetuity.

Although aware of the implications of the SSI legislation, Kadima and Silesia eventually purchased the land which incorporated the Site of Scientific Interest from Powell. In a development application of 1971, the companies flagged the apparent inconsistency that resulted from the trust's policy of asking for the 'minimum amount

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34 McBriar, in her [1966] report to the GSA stated that in fact the limit of the proposed area of the desired reserve incorporated 156 acres, not 100 as formerly and subsequently claimed: 81 acres within the Sandison/Powell Estate and 75 within Sheidow’s property.
35 See 'cautionary note' from C W Bonython, MS of minutes of the second meeting of the National Trust's Subcommittee on Hallett Cove, 19 December [1966]: 'Apologies from Mr Bonython & cautionary note advising not asking too much in case get nothing' (Hallett Cove Papers).
37 Note from Dean Berry to Don Dunstan, Premier of South Australia, 22 December 1967 (Hallett Cove Papers).
of land' required. Although cognisant of the scientific arguments for preservation of the area, the companies were 'unable to find a consolidated case as to why the boundaries of the reserve were drawn as they were'. Accordingly they sought 'independent' scientific appraisal from the Perth-based 'ecological and analytical consultants', Environmental Resources of Australia, to satisfy themselves of 'the scientific merits of the gazetted boundaries' and to make a case for 'rational definition' of the SSI based around the investigation of 'a responsible scientific organisation'.

The report concluded that the land most suited to 'high value urban development', although alienated from the companies by the reservation boundaries, did 'not show any features of geological significance'. Moreover, the importance of the 'archaeological sites' north of Waterfall Creek did 'not warrant their preservation as Sites of Scientific Interest'. Further apparent inconsistency was evident in the treatment of the Amphitheatre:

If the formation is of such importance why should it be reserved in part only and only on one owners [sic] land? … Why should one owner of land not be allowed to disturb the amphitheatre when a government department recommends major earth-moving on an adjoining part of the amphitheatre on another developer's property? The previously referred to relative insignificance of geological and archaeological interest of the headlands on either side of Waterfall Creek also points to arbitrary definition of [boundaries] … At the present time the foreshore and clifftop areas are subject to considerable depredation from humans and from vehicular intrusion … Vegetation is being damaged, erosion is being compounded and the natural landscape is being defaced. Continuing agricultural use of the property within the reserved area must be held to be destroying archaeological remains of

38 T S Martin and Associates, 'Hallett Cove development application'; Cockburn, "Not detrimental", 1; Caldicott and Geering, 'Operation Hallet', 113.
41 T S Martin and Associates, 'Hallett Cove development application', 8.
ancient campsites.42

The application concluded that 'the present definition of Regulations Area boundaries is inconsistent, arbitrary and discriminatory as applied to land held by the Companies and scientific evidence is evinced to prove that boundaries should be redefined'.43

Opponents countered that a West Australian company which specialised in marine science was not suitably qualified to judge the geological and archaeological merit of a canonical South Australian site. Kadima and Silesia were unsuccessful in their application to develop fifteen acres of land within the perimeter of the SSI.44 Indeed, ensuing public outrage contributed to the State Government's decision to acquire it in 1972.45 But the Environmental Resources report emphasised the confusion surrounding both the legislation and the specification of the boundaries.

However valid the trust's subsequent rationalisations, the policy mystified supporters and opponents of development at the cove, and the SSI legislation provided only limited protection. But 'geological heritage' was fairly unfamiliar territory in 1965. It was a steep learning curve for both scientists unseasoned in the 'destructive, exploitative', 'rapacious' ways of urban development and for would-be subdividers unaccustomed to the 'protracted manoeuvres' and 'emotional political opportunism' of groups such as the National Trust and the Geological Society.46

McBriar helped stir an eclectic concoction of 'crusaders' – scientific and lay, individuals and organisations, from home and abroad, with a diversity of agenda and political affiliations – which mix continued into the final stage of the campaign.47 From 1965, sympathetic coverage sporadically featured in the Advertiser and other

44 See correspondence, Hallett Cove Papers: E M McBriar, Convenor, Geological Monuments Subcommittee, GSA (SA Div.) and W Fander, Chairman, GSA (SA Div.), to S B Hart, Director of Planning, State Planning Office, 14 September 1971; C W Bonython, President, National Trust of South Australia, to S B Hart, 20 September 1971; Dr B Daily, Senior Lecturer, Department of Geology and Mineralogy, University of Adelaide, to L J King, Member for Coles, Attorney General's Office, Adelaide.
45 Bonython to Hart, 20 September 1971 (Hallett Cove Papers).
47 For example, see letters of support from interstate and international geologists; notes on the Third Annual Gondwanaland Symposium which held a field trip at the cove; letters to the editor in the Advertiser, 1966-1976 (Hallett Cove Papers).
Adelaide papers and several feature writers, most notably Stuart Cockburn, adopted the cause as their own (see Plate 14 for example of support for the campaigns).

1971-1976: The Hallett Cove Development Company misjudges the tide of public opinion and gets caught in the rip

In 1970 the Hallett Cove Development Company proposed to develop land to the south of the SSI, within the Amphitheatre, as a marina and boat haven. Building materials were to be acquired by quarrying stone from the same area. At the same time, Kadima and Silesia proposed to develop fifteen acres of the SSI as prime beachfront residence. A media hubbub ensued when news of the plans were prematurely aired in September 1971.

While heritage bodies, University of Adelaide geologists and the Geological Society were at the vanguard of the earlier campaigns, the 1971 'battle' saw an unprecedented level of 'grass-roots' support and partisan media participation as the Adelaide Advertiser increased its support for the 'Save Hallett Cove' movement. Between 15 September and 22 September 1971, at least twenty articles, cartoons, editorials and letters pertaining to Hallett Cove appeared in the Advertiser, and several more appeared in the Sunday Telegraph and the News.

Members of the National Trust, Geological Society, Field Naturalist Club, University of Adelaide, the Town and Country Planning Association and State MPs such as Richie Gun and Don Hopgood (later state Minister for Environment and Planning) continued to play prominent roles. But the public campaign was spearheaded at a local level by Marion Shire residents like Cumberland Park garage manufacturer R S Alcock and 'Morphettville mother of four' Jean Minards, respectively the president and the media liaison officer of the 'Save Hallett Cove' committee:

Many organisations supported extended conservation [of the cove, including] a spontaneously formed local group of citizens constituting the 'Save Hallett Cove Committee', students from Adelaide University and from other tertiary institutions, secondary and primary schools. Support for the campaign was overwhelming and gratifying – it came from all parts of the State and from as far
On 10 September 1974, Dr Richie Gun, Member for Kingston, who had received several representations, invited the Federal Minister for Environment and Conservation, Moss Cass, to visit the area, in company with Maud McBriar as a representative of the newly founded Field Geology Club, and other representatives from SASTA, the Marion Council and the State Government. Following this excursion, Gun informed SASTA that Cass had 'undertaken to discuss the matter' with Tom Uren, the Minister for Urban and Regional Development and an architect of the Register for the National Estate. Uren indicated his interest and support in a letter to Gun of 18 September. Cass announced on ABC radio on 10 September that 'it was the Australian Government's responsibility to preserve areas of significance at Hallett Cove'.

Unfortunately applications for National Estate money for Hallett Cove were not granted, due in part to confusion arising from the National Trust's earlier policy in delineating the SSI boundaries, of not 'asking for too much'. But in 1974 the Hallett Cove Development Company graded the south side of the amphitheatre. This resulted in Federal Government intervention, a change in legislation to prevent such future action by developers, the commissioning of the Hallett Cove study report (the Rudman Report) and the eventual gazetting of the park's boundaries in 1975, which is possibly not the result the company anticipated when it brought in the bulldozers.

**Geological heritage and the 'outdoor laboratory'**

The residue of another historical glaciological inquiry provided some of the impetus in the campaign to preserve the Kosciuszko Tops in the 1950s, fought by A B Costin and the Alpine Ecology Unit of the CSIRO and by the Academy of Science. An obvious resonance with Hallett Cove is the rhetoric which insisted on the importance, of both these early sites of scientific controversy, as much a part of Australia's intellectual history as the countryside itself is part of its aesthetic, scientific and...
economic heritage, and of the area in general as a site of ongoing research into glaciation in Australia. Another was the campaigners' claim to an invaluable teaching resource, an outdoor classroom or 'laboratory'.

So the Kosciuszko Tops debate was a possible precedent for Hallett Cove and many parallels emerge, but it does not actually seem overly to have influenced the scientific campaigners in the latter case. The Hallett Cove campaigners instead connect their genealogy with the efforts of the Nature Conservancy movement in the United Kingdom in the 1930s and 40s. The last phase of the campaign bears comparison with the Little Desert campaign in Victoria. The modern conservation park is commensurate with such sites of geological and scientific heritage as Lyme Regis in Dorset, the setting for part of Jane Austen's novel *Persuasion*, best known for the lower Jurassic marine fossils which abound in its cliffs, and Wren's Nest National Nature reserve in Dudley, Worcestershire, which is renowned as both a Silurian fossil site and also as a monument to the Industrial Revolution. The National Trust and the Geological Society of Australia have initiated a 'glacier trail' linking several sites along the Fleurieu Peninsula, such as Rosetta Point (mentioned in the extract by Charles Laseron in Chapter Four), the Inman Valley (site of 'Selwyn's Rock' – see Chapter Five) and Hallett Cove (Plate 15). A similar project in Wisconsin, run by the Wisconsin Ice Age Park and Trail Foundation, manages a thousand-mile national and state 'scenic trail', which links sites of a more recent glaciation, that of the terminal Pleistocene. The foundation seeks to 'tell the story of the Ice Age and continental glaciation along a scenic foot path', an undertaking which

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53 Robin, 'Radical ecology and conservation science', 198-9. The smattering of 'iconic' scientific surnames over the landforms of the area even evokes some of the same personalities, most notably, 'David Moraine', after Edgeworth David.

54 Robin, 'Radical ecology and conservation science', 197, 198 (from a botanical perspective as much as a geological one).


resonates with the Fleurieu Peninsula trail.  

Michael Hall wrote in 1992 that the 'creation or continued protection of a national park or wilderness area is not a rational process. It is a political battle'. While not a 'wilderness' or 'primitive' area, the rhetoric of the Hallett Cove 'campaign' is steeped in the same language of struggle. Some of the vocabulary of 'primitive areas' and 'wilderness' was in any case invoked in depictions of the cove during the campaigns. For example see references to 'primitive', 'Natural state', and fears that 'the entire landscape will be domesticated and "prettified", and its present character will be erased'. One writer insisted that changes would be 'as disastrous to the wonderful inshore natural formations as would be the conversion of Morialta Falls reserve or Wilpena Pound to a new respectable suburb'. The cove's geology perhaps evokes the 'wilderness' of the deep past. Although undoubtedly a cultivated landscape, its rugged, eroding cliffs, badlands features and scrubby vegetation, surrounded by suburbia as it now is, place it somewhere between domestication and wildness.

The 'battle' for the cove has been labelled 'the first step towards the invigoration of community environmentalism in South Australia'. And despite the establishment credentials of many of the key scientific organisations which lobbied to protect Hallett Cove, the campaign has been constructed, both retrospectively and in the press reports of the time, as a crusade against 'exploitation' (as opposed to rational, environmentally sensitive urban planning), as a recognition of the power of

61 For quotations see SASTA, 'Hallett Cove today'; Caldicott and Geering, 'Development and disaster'; McDonald et al, 'The conservation of Hallett Cove', np; and footnotes below.
63 See letter to Don Dunstan, Premier of SA, 30 September 1971 (Hallett Cove Papers), expressing concern at recent developments 'relating to proposals for major physical changes of the Hallett Cove area', signed, at a combined meeting on 23 September 1971, by H E Wopfner, President, Royal Society of South Australia; R J Best, Chairman, ANZAAS, SA Division; C W Bonython, President, National Trust of SA; G L Pretty, President, Anthropological Society of SA; H W Fander, Chairman, Geological Society of Australia, SA Division; and B Mason, President, Royal Geographical Society, SA Branch. Representatives of the Australian Academy of Science also wrote in support of the campaign (see letter from the Secretary, Physical Sciences, Australian Academy of Science, to Dean Berry, President of the National Trust of SA, 23 September 1968, Hallett Cove Papers).
64 Comments by prominent South Australian and Federal politicians in newspapers and press releases emphasise this. Notably, see Press Statement from the Premier, Don Dunstan, on 14 October 1971, regarding development at Hallett Cove (Hallett Cove Papers): "We have decided that, in fairness to
the people, as a *victory* for 'education' and the heritage movement in South Australia, and as a *vindication* of the significance of a geological awareness of the landscape.

The 'machinations' and motives of would-be developers were characterised as selfish, underhand, 'questionable', 'based on the gullibility of the public' and their actions 'pillaging', 'exploitative' and 'desecration'. The early protective measures of State Government ministers and departments, where considered to fall short, were categorised as 'tokenistic', 'short-sighted', 'lacking vision', and 'minimal'. The literature of the conservationists consciously likened processes of urbanisation to the spread of a disease or an alien terror, almost mirroring the language of Cold War sci-fi/horror films such as 'Them' and 'Invasion of the Body Snatchers'. Pre-'development' Hallett Cove was a botanical refuge, 'close to its natural condition', a geological Mecca, an invaluable resource, 'a beauty spot', a picturesque landscape, 'a source of beauty and pleasure', a living science lesson and 'St Vincent Gulf's most beautiful natural cove'.

In contrast, the vocabulary of would-be developers, while acknowledging the 'magnificence' of the 'outlook' and the 'panoramic views', stressed the 'deficiency' of the beach, the lack of scenic attraction of the 'steep and broken landform', the 'rapid degeneration' of the area which has been 'defaced', 'denuded' and 'degraded', not by subdivision but by 'agriculture' and by 'uncontrolled public access' resulting from the site's 'isolation'. For an opposing argument, of the unsuitability on pragmatic

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65 See flyer authorised by the Adelaide Marxist-Leninists, 1971, 'The facts about Hallett Cove' (Hallett Cove Papers); also see assorted petitions and advertisements calling on public support (Hallett Cove Papers).

66 For example, anon., 'Exploitation at Cove', *Advertiser* (Adelaide), 27 November 1974; Caldicott and Geering, 'Development and disaster'; Caldicott and Geering, 'Operation Hallett'; SASTA, 'The need for the Government to acquire … Major District Open Space', 5.

67 For example, 'What has been done to keep it intact and protected from the tentacles of urban sprawl and the encroachment of development?' (Caldicott and Geering, 'Development and disaster', 20); 'developer's devouring teeth' (Cockburn, 'Blood is up at the cove').

68 Nancarrow, 'Conservation of geological features', 3; T S Martin and Associates, 'Hallett Cove Papers'.

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grounds of the site for residential subdivision, see the SAIT student report which precipitated stage two of the conservation battle: 'if the subdivided area had particular merit for a residential area, its reservation might be thought more contentious. But on the contrary, it is steep and exposed to the full force of western sun and weather'.69 Similar points, about the lack of viability for intensive settlement of particular areas of northwestern Victoria slated for development, were made of Sir William McDonald's Little Desert Settlement Scheme during the campaign to save that area in 1968.70

The Hallett Cove campaigners' language is occasionally that of a prelapsarian wilderness 'nature in its untamed state' – 'magnificent and unspoilt'.71 Consider for example 'the whole experience of the wind on the hills, the loneliness of the deserted beach, the long stretches of nature undefiled and timeless' and the 'stark and rugged character of the hills above the cliffs' of the cove which while 'close to its natural condition' was 'a source of beauty and pleasure'.72 'Subsequent' development 'destroyed the whole character' of the cove.73 Adelaide resident P Schwerdtfeger wrote to the Advertiser in July 1974, after the Hallett Cove Development Company graded the south side of the Amphitheatre, lamenting that

The grading of the terrain above the beach … can only be described as an act of total naivety or irresponsibility. The background provided by a brutally obvious railway embankment hardly enhances this sordid scene. The foreshore of Hallett Cove is gone and SA has allowed yet another unique landmark to be senselessly scraped off the map.74

This is patently at odds with the 'reality' of the Hallett Cove landscape which had

69 McDonald et al, 'The conservation of Hallett Cove', np.
70 Robin, Defending the Little Desert, 90-112.
71 McDonald et al, 'The conservation of Hallett Cove', np; Dr B Daily, University of Adelaide, to L J King, Member for Coles, Attorney General's Office, Adelaide, 20 September 1971 (Hallett Cove Collection).
73 For example, Caldicott and Geering, 'Operation Hallett'; SASTA, 'The need for the Government to acquire … Major District Open Space'.
been grazed, mined and farmed for well over one hundred years, as pointed out by
spokesmen for the development companies who declared that 'there has been some
emotional thinking on the subject'.\(^75\) It was also disingenuously heedless of evidence
for pre-European habitation and modification of the landscape in the form of 'tool
factories' and fires which 'Flinders saw' in 1802 'when sailing up Gulf St Vincent'.\(^76\)
However the degree of disingenuity in the vocabulary of the campaigners is tempered
by a genuine sense of grief at the perceived or imminent 'loss' to the South Australian
public of 'yet another unique landmark' and anger at the bureaucratic opacity,
hypocrisy and lack of consultation that leads to such 'decay'.\(^77\) As an editorial in the
*Advertiser* claimed in September 1971,

> Once again, a local council, this time the Marion Council, appears
to have abandoned the interests of the environment … Surely
Adelaide has enough subdivided, bituminised, despoiled and
ruined beaches without adding another? And surely now is the
time to arrest the development which is making almost the entire
coast … into one unattractive and undesirable conglomeration? …
the Marion Council's approval of quarrying at the Cove has made
one point, already evident at Stirling, very clear. As part of the

\(^75\) R C Chapman, for the Hallett Cove Development Company, to G R Broomhill, Minister for
Conservation and the Environment, 23 July 1971 (Hallett Cove Papers): 'There has been some
emotional thinking on the subject of conservation in this area. There is not the universal awareness that
conservation includes … controlled development and utilization of natural resources'. See T S Martin
and Associates, 'Hallett Cove development application', for Kadima and Silesia Development
Companies' comments on the degradation of the land due to clearing and farming.


\(^77\) Horr, 'Preserving heritage': 'A nation falls into decay when its standards are so lowered that only
material benefits are of account'. See also Anon., "Subdivision "Instance of sprawl!": 'the destruction of
a wonderful and unique series of features … the blurring and dissipation of the stark, rugged
character'; anon., 'Rain turns sea red: Federal look at H. Cove', *Advertiser* (Adelaide), 7 July 1974, 26:
'The worst predictions of the conservationists and scientists who have fought for years to preserve the
area against close development seem to have been realised'; J Bromell, 'Choice of word', Letter to the
Editor, *Advertiser* (Adelaide), 16 September 1971, 2: 'Imagine the word "opportunism" being used by,
of all people, a developer!'; J D Chittleborough, 'Doubts on Cove plan', Letter to the Editor, *Advertiser*
(Adelaide), 16 September 1971, 2: 'Are they all convinced that a breakwater, marina, motel and so on
will really enhance the attractiveness of the area for the average citizen? I confess to becoming
emotional if "experts" try to convince me that a delightful beach with sand, rocks and dunes … needs
"developing" in the way proposed'; Cockburn, 'Another threat for Hallett Cove', 1: 'Leading geologists
and conservationists said yesterday they were appalled by the news'; SASTA, 'Hallett Cove today':
'The wheels of progress grind rapidly onwards and the general public seems unable to halt such
progress'; 'Dr Cass, who inspected the area today, said he was concerned and angry that developers
were wanting to make enormous profits out of land at Hallett Cove, at the expense of the geological
significance of the area'.

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State's heritage, the best of the environment cannot be left to the hands of local government.  

The general lack of topographic loftiness west of the Great Dividing Range effected a local understanding of places worth saving in South Australia at odds with the monumentalism sometimes associated with the establishment of national parks in, for instance, New Zealand or the United States, although the message was no less one of grandeur. In the 1950s wilderness was a 'hot political issue'. Libby Robin, writing about the Little Desert campaign of the late 1960s, stated that the Little Desert National Park was seen as a 'monument to lost wilderness, an element of the past retained for the future … It was the holistic ideal … that conservationists sought to defend'. Likewise the campaign literature of Hallett Cove insists on the need to preserve the site, with its 'almost unbelievable glimpses of the past ', for 'the future'.

If 'the geographical circumstances of South Australia required the creation of a … system that could overcome the paucity of snow-clad mountain-top scenery', then the monumentalism of deep time in the intimate setting of Hallett Cove provided just that. For example, the GSA (SA's) nomination of Hallett Cove to the Register for the National Estate in 1977 describes the glacial features as 'a world renowned area of geology', the 'best of the (late Palaeozoic) Australian glacial pavements … amongst the best in the world'. The park boundaries protect a 'world renowned area of geology' preserving the glacial pavements 'in relation to older and younger rocks' thus revealing aspects of 'the geological history over the last 600 million years'. Not only qualitatively the 'best in the world', the cove rocks tell a story of South Australia spanning the top eighth of earth history.

The initial push to 'save' Hallett Cove came from academic geologists, some of whom were also members of the fledgling National Trust of South Australia, incensed at the proposed destruction of an 'iconic' scientific site and concerned to protect their 'outdoor laboratory' to help train future geologists, and from South Australian heritage and school groups eager to preserve an 'outdoor museum' of

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78 Anon., 'Conservation and the Cove', 2.
79 Robin, Defending the Little Desert, 16-17.
80 Hall, Wasteland to World Heritage, 128.
81 [B J Cooper], 'Nomination of Hallett Cove to the National Estate on behalf of the Geological Society of South Australia', unpublished MS, 21 April 1977 (private collection of B J Cooper).
global significance.82 It was certainly an idea whose time had come: already in 1965, deserts were regarded as 'landform museums rather than scenes of rapid destruction' and Australia had been described as 'the world's foremost soil museum'. 83 The first mention of the need to preserve the cove as a 'practical teaching area' might have occurred in December 1961, when Norman Tindale, then Chairman of the Nature Preservation Committee of the National Trust, proposed it at a committee meeting. 84 Dean Berry provided a succinct account of the value the trust placed in the site as an educational resource in a letter to Maud McBriar:

The whole area shows unique evidence of Permian glaciation and there are exposures of other rocks spanning a period of more than 600,000,000 years. This makes it virtually an open air demonstration room for students of geology at all stages. On the same ground there are archaeological remains, including aboriginal campsites and a 'factory'. 85

The 'cameo' of Hallett Cove shows earth-history-in-the-making, conveniently close to Adelaide. It provides the possibility for a series of vignettes: 'There is more to teaching Earth Science than a simple examination of rocks. That much of the exercise can be performed in the class room. It is only when students see rocks in relation to other rocks and to the overall topography of the area that they develop the kinds of attitudes to the subject which all good teachers are striving to achieve'. 86

Campaigners like McBriar, Graham Whitten, Brian Daily, and members of the South Australian Science Teachers Association (SASTA) argued the case for

82 R L Sangster to G R Broomhill, Minister for Conservation and Environment, 30 September 1971 (Hallett Cove Papers). 'The late Sir Douglas Mawson was convinced of the geological importance of the Cove, and it was he who first told the writer of the rare glacial pavement there'; Bonython et al, 'Submission to committee appointed ... to enquire into the preservation of Hallett Cove', np; Ellis and Warnes, 'Hallett Cove Conservation Park, an environmental resource'; Rudman Report; SASTA, 'Hallett Cove today'; E M McBriar, 'Notes on Hallett Cove for Mr Hiles, secretary of the National Trust', unpublished TS, 8 November 1968 (Hallett Cove Papers), np: 'Is it any wonder that for many years this area has been used as an open-air museum for the instruction of hundreds of students annually? In addition, it is a mecca for visiting geologists interested in glaciology and is the pride of local geologists'.


84 Clarke, 'Hallett Cove ... notes on preservation', 8; [Toteff], Hallett Cove Conservation Park, 14.

85 Dean Berry to Maud McBriar, 1 March 1967 (Hallett Cove Papers).

86 SASTA, 'The need for the Government to acquire ... Major District Open Space', 4.
'landscape as a training resource' at Hallett Cove from early in the 1965 campaign to establish their credentials among industry geologists and a public which was riding high on a national minerals boom. For example, SASTA explained that no site 'enables a student to take in such a wide range of Geological history in one excursion' as Hallett Cove, which is 'unique as a teaching aid', in that 'the same area can be given a simple interpretation suitable for Primary school students or a complex interpretation posing problems at tertiary level'. Furthermore, it is 'still close to its natural condition and within a few miles of a capital city'. H A Lindsay wrote in the Advertiser in 1965 that in Hallett Cove, the state had 'valuable areas for the field studies which are essential for the training of geologists – and it is our geologists whose work leads to the discovery of mineral wealth'. An article in the Advertiser in late December 1967 explained that the cove had 'made possible extensive knowledge of Australian stratigraphy which had contributed, and would continue to contribute, to exploration for oil, gas and other minerals'. A letter to the Australian newspaper in September 1971 repeatedly stressed the (unspecified) 'mineral phenomena' of the cove that would be threatened by subdivision.

This was not just political opportunism, as argued, for example, by R C Chapman of the Hallett Cove Development Company. It was also necessary not to alienate those members of the Geological Society who relied on extractive industries for a livelihood. The distinction between 'industry' and 'academic' geologists is often blurred. Many scientists were active in the Geological Society, tireless campaigners for Hallett Cove, and also worked for a mining company. However, others felt that the Society should not oppose 'development' as to do so would set a precedent which could have ramifications for the industry.

Most campaigners were infused with genuine pedagogical commitment. Their belief in and commitment to the overweaning importance of the site as a teaching
resource, as a monument to the history of the discipline, as a testimony to South Australia's deep past and as a site of 'outstanding' geological interest and 'global' importance in its own right were unequivocal. However a pragmatic public focus on the economic relevance of the scientific value of the site continued throughout the years of the campaign and into the 1980s.

Early recognition of its 'glacial' relics brought the site to scientific notice in South Australia and kept it there during 120 years of controversy and exegesis. Its glaciological significance was central to the National Trust's efforts to secure the Sandison Reserve and remained important throughout subsequent campaigns. Those landforms still brand it as a 'premier', 'priceless', 'unequalled' or 'world class' locality for the study of the Permian Ice Age. But another string to its geological bow was increasingly articulated from 1968 onwards and continues to be celebrated in recent cove literature – the significance of Hallett Cove as a piece of the four dimensional mobile global jigsaw of plate tectonic theory:

These [glacial] features … when considered along with similar evidence from the other continents of the southern hemisphere and peninsula India, provide strong confirmation of how the present continents packed together before the breakup of the primeval continent of Gondwanaland … [I]mportant though the quality of these glaciated pavements is, it is the clear way in which they are displayed in relation to rocks both older and younger which makes Hallett Cove unique.91

Further, notes from informal surveys by Open Day guides in 1976 and 1977 emphasise the degree of public interest in continental drift theory (see Plate 16 for an example of the use of a 'Gondwana logo' at Hallett Cove).92

In a feature in the News of 20 September 1971, Maud McBriar emphasised Hallett Cove's 'Gondwanan' credentials for the elucidation of 'a lively theory': 'One exciting point is that these rocks relate this part of the world to continental drift – a lively theory that Australia was once part of an ancient continent that embraced South

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91 SASTA, 'Hallett Cove today', 36. For other examples see Bourman and Alley, 'Troubridge Basin', 65-70; [Cooper], 'Nomination of Hallett Cove to the National Estate'; FOSAM, 1996; Giesecke, A Field Guide to the Geology of Hallett Cove; NPWS, 'Hallett Cove Conservation Park'; Rendle et al, 'Preserving Heritage at Hallett Cove'.

92 Notes by Open Day guides in Hallett Cove Papers.
Africa, India and Antarctica'. One of the strongest arguments submitted by SASTA in a report to the State Government in 1971 argued that as a 'key in the development of theories of the Earth's changes as a whole and not just in a specific locality, state or continent' the cove should be 'kept as a well protected unit to enable intercontinental correlation'. An Advertiser article of 4 April 1975, quoted the State Minister for the Environment and Conservation, Mr Broomhill, speaking in support of the 'Save Hallett Cove' Committee, which had presented to him 'new evidence' showing 'the importance of continental drift patterns at Hallett Cove'. It is worth noting that Broomhill's new-found fervour for the preservation of the cove, though he had early in 1971 supported in principle an application to quarry the south end of the amphitheatre, might have been influenced by the letter which accompanied the deputation, from Tom Uren, who had already pledged his support, and by the clear swing of public opinion in favour of preservation.

A letter to the Editor in the Advertiser of 22 September 1971 from a University of Adelaide honours student in geology, R F Harris, pointed out that 'the 50-acre site of scientific interest does not include all the important items at Hallett Cove. The cove, the foreshore and the adjacent cliffs have not been fully studied. These contain rock features not found elsewhere and the only fossil locality in glacial rocks at Hallett Cove. With the … present plan all these will be bulldozed'. On 18 June of the same year, Harris sent a submission to Broomhill and the Director of Planning, Hart, setting out his case more comprehensively for the protection of 'certain unpreserved relics of our geological heritage' which have 'not been studied in the light of modern developments in sedimentary Geology'. Furthermore, 'much of the Permian rocks are imperfectly described, despite this area being "classic ground in Australian Geology". Thus the fact that areas have not been previously reserved does not mean such areas are unimportant'. This suggests a degree of disingenuity on Broomhill's part, as the letter from Harris demonstrates his awareness of the 'new evidence' four years before he moved to support the Save Hallett Cove Committee's

93 Anon., "Relax" is a foreign word', News (Adelaide), 20 September 1971.
94 SASTA, 'The need for the Government to acquire … Major District Open Space', 3.
95 I Steele, 'Cove move urgent – Broomhill', Advertiser (Adelaide), 4 April 1975, 7.
96 R F Harris, 'Cove not studied', Letter to the Editor, Advertiser [Adelaide], 22 September 1971.
97 See correspondence in Hallett Cove Papers.
demands for extending the park's boundaries. A Sunday Mail article announcing one of several public open days at the cove, on 17 October 1976, promised that 'geologists will show the secrets Hallett Cove has yielded about the age when the land mass that is now Australia broke away from Antarctica 45 million years ago and 40 million years later was submerged beneath the sea in this area'. In a submission from the Save Hallett Cove Committee and the Conservation Council of South Australia, Uren was told in no uncertain terms that Hallett Cove 'provides one of the finest pieces of geological evidence that this land was linked with Antarctica'.

This submission enticed with its potential for economic geology as well, with the claim that 'the theory of plate tectonics, involving continental drift, explains the present shape and distribution of continents on our earth and gives new insights into the search for mineral resources'. It is symptomatic of a philosophical change between the 1957-65 negotiations and the later campaigns: 'When this was a rural district it seemed sufficient to hold a token strip of land along the cliff-top … however the emphasis has changed to a more comprehensive study of the geology here … lands which lie outside the present buffer zone will continue to yield more scientific data as they are further researched for their geological and archaeological contents'.

Both academic and popular literatures – the latter in the form of Friends of the South Australian Museum (FOSAM) and NPWS brochures – privilege the site's geological importance over other aspects of its history and heritage. McBriar wrote, candidly in 1971 that 'The case for reservation of an additional area of land was based almost solely on the need to preserve the geological features, although some

98 See also Letter from Tom Uren to Ralph Jacobi, Federal Member for Hawker, 23 April 1975 (Hallett Cove Papers): 'Recently I have received urgent representations from Mr Broomhill, regarding a deputation to him which claimed that the area of geological significance at Hallett Cove is greater than originally suggested'.

99 Francis, 'Tours of ancient rock site'.

100 The Conservation Council of South Australia represented 24 organisations with state-wide membership, including the National Trust, the Nature Conservation Council and the Field Geology Club. The submission was also signed by as diverse a range of organisations as the Geological Society, the Hallett Cove Beach Progress Association, SASTA and the Gem and Mineral Society.

101 Save Hallett Cove Committee, 'Save Hallett Cove urgent', Advertisement, Advertiser (Adelaide), 31 March 1975; notes prepared for Uren on 10 September 1974 describe Hallett Cove, 'a national heritage', as 'a vital link' to other continents of the southern hemisphere 'in theories regarding the break-up of the primeval continent of Gondwanaland by the drifting apart of the present continental masses'.
consideration was given to protecting the relics of the former aboriginal inhabitation'. At the same time, a SASTA submission complained that 'the [flora] and the anthropological importance of the cove are too easily overlooked'.

Humanity is sometimes written out of cove history altogether, in an eagerness to play up the Cove's 'wilderness credentials': 'the loneliness of the deserted beach, the long stretches of nature undefiled and timeless'. But in contrast to the Little Desert National Park, the need to preserve aspects of the human past of Hallett Cove has also been integral both to the campaign and to subsequent interpretation of the site.

For example, the Worthing Mine site is a 'relic' of mineral exploitation in South Australia. Graeme Pretty, then the President of the Anthropological Society of South Australia, wrote to Maud McBriar in May 1975, citing the importance of the archaeological material above Waterfall Creek as a site of 'Ancient Man at Hallett Cove, notwithstanding [its] lack of ruined walls and street alignments'. He envisaged that, properly protected, Hallett Cove 'will enable Australia to memorialise Ancient Man's way of life in a unique way'. In keeping with the Little Desert situation outlined by Robin, the human heritage – both Indigenous and European – that is venerated at the cove is a humanity of the past, not a celebration of living culture. It is a form of value-adding. As Caldicott and Geering wrote in 1974, 'The presence of relics of former Aboriginal inhabitation and other settlement also add to the value of the Cove'.

The campaign was unprecedented in the history of the Geological Society of South Australia. McBriar and other pioneers in the field of geological heritage in

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102 McBriar, 'A brief note on the conservation of Hallett Cove', 1; SASTA, 'The need for the Government to acquire ... Major District Open Space', 4 – cf the Willandra Lakes and in particular Lake Mungo where the situation is reversed and the material remains of the human past are privileged and emphasised above the intriguing geomorphology of the system.

103 Horr, 'Preserving heritage'.


105 Graeme Pretty, President, Anthropological Society of South Australia, to Maud McBriar, 6 May 1975, (Hallett Cove Papers).

106 Caldicott and Geering, 'Development and disaster', [my italics].
Australia got many of their ideas from the Nature Conservancy Council during several visits to the UK in the 1960s. The Geological Monuments Subcommittee of the Geological Society of SA was formed largely as a result of the Society's involvement with the Save Hallett Cove Campaign, and the battle marked an early fight for the newly formed Nature Preservation Committee of the National Trust of South Australia. This subcommittee, subsequently re-named 'Geological Heritage' first met on 10 March 1967 and consisted of Arthur Alderman, P Allchurch, Brian Daily, Graham Whitten, with Maud McBriar as Convenor. McBriar and Whitten were also representatives of the National Trust's Hallett Cove Subcommittee 1966-1971.

There are now Standing Committees on Geological Heritage in every state division of the GSA, although some are much less dynamic than others, and the South Australian branch remains very active. Professional geologists are not traditionally considered to be pro-conservation, but in this fight, academia, government and industry banded together to protect both the history of the discipline and the landscape history embedded in the Cove. There are many within the Society's ranks who oppose 'Heritage listing', on the grounds that it is not in the best interest of the mining industry as McBriar, in her role as Convenor of the Geological Monuments Subcommittee, explained to the Director of Planning in July 1971:

Geologists within the Society are divided on the proposal being canvassed by various conservation bodies and the Conservation Council of South Australia for the creation of a Major District Open Space in the area. The Society has not adopted any policy on this matter but has left it to individual members … many have signed the petition that is currently being circulated, but others do not support it.  

It is significant that for all its efforts in the name of geological conservation, the

Geological Monuments Subcommittee has only once directly opposed a mining interest – sand-mining of the dunes along Yankalilla Bay in the vicinity of Normanville.111

Managing Hallett Cove

The Hallett Cove Conservation Park and the Sandison Reserve were primarily preserved for the cove's value as a geological site, but the park is managed by the National Parks and Wildlife Service – which is intrinsically opposed to extractive industries. In this case geologists and NPWS both seem to be handling potential conflict rather better than, for instance, professional palaeontologists and NPWS at the Riversleigh World Heritage Site in western Queensland, but there are still inconsistencies.112 Traditional forms of National Park and Heritage management are considered inappropriate for the needs of a geological site and tensions abound where the needs of researchers clash with the anti-extraction policies of National Parks management.

Hallett Cove is an oft-celebrated but nonetheless equivocal success. Its proximity to densely settled suburbs is problematic. Some geologists and members of the National Trust of South Australia maintain that the scientific value of the park and reserve is compromised as potentially important sites whose geology has not been investigated were and continue to be lost to housing.113 Vandalism has been a problem at times, particularly the damaging of interpretive signs and dioramas. There is a conflict between the management requirements of a Conservation Park, a scientific resource, and the need for urban public spaces. Given the density of the settlement around Hallett Cove, its custodians fear that recreational use will spill over into the geological reserve and put extra pressures on the site, not to mention the potential ravages of unrestricted amateur or illicit commercial rock-collecting.114


113 Caldicott and Geering, 'Operation Hallett'; Cooper, pers. comm., 26 January 2000; Harris, 'Cove not studied'.

114 See, for example, letter from Howard Murton, Yuncken Freeman Architects Pty. Ltd., to E M McBriar, Geology Department, University of Adelaide, 28 July 1976, regarding an advertisement in the Advertiser (nd) on behalf of the Hallett Cove Development Company which 'misrepresented' the purpose of the park 'by implying that it is a place set apart for gemstone fossicking or such like'. (Hallett Cove Papers) See also [Toteff], Hallett Cove Conservation Park; Rudman Report; who
1976, the Rudman Report recommended the creation of a public reserve a little distance from the conservation park to avoid such overlap.
Hallett Cove and geological knowledge

Edgeworth David's precocious epitaph for the glaciation controversy in Australia fittingly introduces a concluding reflection to this essay. Hallett Cove and glaciation form the connecting threads in an investigation of the power of deep time to rescue and canonise a landscape. What does this story tell about the way the earth sciences are made? Geological knowledge, like all knowledge, is made in part by processes of negotiation and consensus. Similarly, the aesthetic and heritage value of a place is a matter of public negotiation and consent.

The contribution of the material landscape of Hallett Cove to debates about time depth in Australia is partly an artefact of the dependence of the earth sciences on the physical remains of the past. The more information physically available to geologists, the more that can be deduced about the material earth. As more information was obtained from and about the earth, so were more sophisticated and precise conjectures possible. The sheer quantity of information necessitated a greater degree of specialisation within the discipline. Tate, Howchin and David were geological jacks-of-all-trades with eclectic sub-disciplinary proficiencies that are luxuries rarely available to modern geologists. This is not to imply a deterministic progression from state of ignorance to one of enlightenment, simply that in a field science such as geology, the discovery of new territory and of new material remains of the past contribute to a fuller, though not necessarily more accurate, understanding of it.

The intrusion of Hallet Cove's municipal history into its intellectual and geological stories introduces the phenomenon of the mobilisation of the deep past, its material remains and its intellectual legacy, in the interests of 'geoheritage' and the

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1 David, 'Evidences of glacial action in Australia and Tasmania', 58.
establishment of a collective national treasure chest of places worth saving. Hallett Cove as a storehouse of information about Australia's deep past is thus a national resource. Those involved in the last part of the conservation battle described in Chapter Six tended to represent the need for an expanded park in terms of the earlier failure on the part of geologists, the National Trust, government and the public to understand the importance of the un-reserved areas, which they all now appreciate. It is not so much that faulty comprehension was illuminated, rather that value in the landscape was increasingly re-inscribed in geological terms during the late 1960s and early 70s. It simply became easier for the geological community to alert the South Australian public to the 'importance' of the cove landscapes.

The aggregate that makes up Hallett Cove reflects more than five hundred million years of landscape evolution. Its 'outdoor museum' is a shifting stage in an ongoing process of deposition, uplift and erosion. An overburden of cultural and social history is apparent in stone tools on the cliff tops, Aboriginal landscape histories, remnants of beach huts, floral distribution, wooden walkways and fences, and the housing estates which now press at the hems of the conservation park. Its decoding has a genealogy reflecting intellectual trends, patronage, technological innovation and switching allegiances, both personal and national.

The story of deep time at the cove is broader than debates about glaciation or controversy about zoning. For geologists, it is the clear conjunction of former worlds and the global importance of its Gondwanan inheritance that are draw cards as much as the specifically glacial features preserved within the park's boundaries. Its theme park nature is unusual in Australia. The area records the legacy of mountains and seas, sites of Aboriginal and European settlement and encounters, smuggling, copper mining, subdivisions, conservationists, beach huts, botanists, geology students and a Mobil refinery at Point Stanvac, recently closed. Such a landscape is a composite of chemical, mechanical and social legacies, formed and conceived in different ways at different times. But to geologists viewing landforms in the park, the clear association of several lost geographies takes on a global significance as the slow dance of former continents becomes the bedrock of time to come (Plate 17).

PLATE 8. Stratigraphic section at Black Cliff.

Annotations show how the stratigraphy relates to the panels of Chapter Four. The bright red lines represent major unconformable boundaries, soft red lines in the lower half of the image outline folds of the Delamerian Orogeny.

(Photo K Douglas)
PLATE 9. Map of South Australia showing the extent of the Adelaide Geosyncline.

The Adelaide Geosyncline is a sedimentary basin which collected silts and sands during the Proterozoic. These later consolidated and were deformed during the Delamarian Orogeny. Their remnant now forms the siltstones of the shore platform and Black Cliff (see Plates 8, 10).

PLATE 10. Shore platform beneath Black Cliff (photo K Douglas).

The eroded limb of a fold is visible in the shore platform, plunging to the southwest, a remnant of the Delamerian Orogeny (see Panels 1-2).
PLATE 11. Erratic boulders on the beach and eroding from the cliff south of the Amphitheatre (photos K Douglas).
PLATE 12. Pavements above Black Cliff showing grooves or striations from the passage of glaciers during the Permo-Carboniferous (photos K Douglas).
PLATE 13. The formation of striated pavements, glacial tills and erratics in a glacial lake.

As the glacier moved west, the bedrock beneath was abraded, leaving striated pavements like Tate's Rock. Icebergs calving into a lake at the retreating end dropped boulders and gravel as they melted (see Plates 11, 12).

considerably. This whole affair is a perfect example of how monopoly capitalism operates in our society. Big Business (eg ANZ Bank) manipulates our so-called democratically elected representatives (eg Marion Council, which is, incidentally, predominantly Labor) in order to secure the greatest possible profits. Because of their economic wealth, monopoly capitalists are able to exercise political power and control the rest of the society. Obviously, it is not the wishes of the majority of the people which determine the fate of our environment, or of any other matter in society but the profit-seeking interests of Big Business.

Oppose Monopoly Capitalism

SAVE HALLETT COVE

Come to a Public Meeting . . . . Friday, Oct. 15, 8 p.m.

Pleasant Memorial Hall ............... Cor. Sturt & Morphett Roads,
                                   Seacombe Gardens.

Speakers:  Warren Bonnyman
          Dr. von der Borch
          Dr. N. Broadhurst
          Lance Worrall

Dr. Kelly Ludbrook
Bob Giles (Plumbers’ Union)
Jane Cockman

AUTHORIZED BY ADELAIDE MARXIST LENINISTS.


(Hallett Cove Papers)
PLATE 15. Glacial locations of the Fleurieu Peninsula.

PLATE 16. Friends of Hallett Cove flyer showing the Gondwana logo.

(Hallett Cove Papers)

Note the wooden walkway along the cliff at centre left of the image.
Part Three

Dirt, bones and the Diprotodons of Lake Callabonna:
Discovering the lost worlds of vertebrate palaeontology

They are finding bits of the jigsaw, putting the pieces
back together, peering at a lost world through an
ever-widening window.¹

¹ Elizabeth Smith, 'Lightning Ridge site: The black opal menagerie', Riversleigh Notes: Australia's Lost Kingdoms Special Edition 45, 2001, 8.
Prelude

1892

During October 1892, welcome rain soaked Adelaide and its arable hinterland. Appreciation for 'the grand season' flooded in to the *Adelaide Observer*. At Innaminka on 14 October, correspondents celebrated the Farina mail, twenty-two hours late because of the splendid rain. After half an inch fell in the colony's capital in the week to 3 November, farmers in Yadea were even 'anxious to see fine weather now, so as to enable them to get in their hay which is fit to cut'. From Blinman it was reported that all dams were full and all creeks running; 'a very unusual thing' in October. To drought-blighted pastoralists on the Eyre Peninsula, the growth of feed was 'most phenomenal' and in Orroroo, 'such growth of feed and crops' had 'never been seen before'. The North was saved for the season.

On Tuesday 1 November across the border in Victoria, crowds of visiting South Australians watched rank outsider Glenloth win the Melbourne Cup on a heavy track, and the fashion pages that week reported a daring craze for plaid. The same afternoon in Adelaide Edward Charles Stirling, in his capacity as the director of the Adelaide Museum, delivered a well-attended paper to the Royal Society of South Australia regarding a commemorative copper tablet which Matthew Flinders left at Cape Catastrophe. The museum had recently found it in a drawer. He little realised that by the end of the week his attention, and the city's, would turn to found objects buried far deeper in South Australia's history and of possibly greater significance for its future.

Adelaide had Spring in her step that Tuesday afternoon. Despite the showers, sunshine perhaps warmed a refreshed populace as John Meldrum rode through town after some five hundred miles hard travel, from the Ragless brothers' Callabonna Station on the eastern shore of Lake Mulligan, near the colony's border with northern New South Wales. Cutting a path to the city through desert turned to fen, through a wheat-belt suffering the attentions of too little rain at the wrong time, along the muddy

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2 'Yadea' is perhaps Yardea, a locality on the northern Eyre Peninsula, to the south of Lake Gairdner.
main road from Gawler, through suburban villages glittering with raindrops and past boggy open paddocks and the Park Lands beyond North Adelaide's pleasing but damp asymmetry, the well-digger came burdened with material suggesting that such unexpected weather as impeded his passage might once have been commonplace in the arid northeast of the colony. His discovery of fossil remains of gigantic animals allowed the possibility that climatic conditions in former times were different from (and 'superior to'?) the climate of modern South Australia.

These implications might or might not have escaped Meldrum, but he knew that the news he had to relate and the specimens he carried with him, consisting of the lower jaw of the giant extinct marsupial Diprotodon 'with some of the molars attached', would attract the attention of 'scientific men' in Adelaide. He placed them on view at Mr P Lee's Black Swan Hotel on North Terrace. The bones had suffered on the long trek to Adelaide and so had limited intrinsic value as collectibles. Their importance lay rather in 'the proof of the existence of the giant, extinct marsupial of centuries ago in a locality in which its fossil remains have not hitherto been discovered', and in the tantalising implications of this 'proof' that the desert had once supported large marsupial herbivores in great quantity.5

Such images or the promise of lost worlds pervade the language of palaeontology. The material remains of the deep past act as catalysts to the imagination. The motif of a lost or former world of fantastic or ferocious beasts, now gone, is rehearsed and recycled in various formats, elegiac, educational or sensational. It is expressed in academic and popular science, film, television and art, from Georges Cuvier's 'world previous to ours' to Louis Figuier's *La terre avant le déluge*, from Arthur Conan Doyle's 1912 *The Lost World* and its many cinematic incarnations to Peter Ward's hymn to departed megafauna, *The Call of Distant Mammoths*, and the 'Australia's Lost Kingdoms' travelling museum exhibition.6 For palaeontologists and

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5 Anon., 'Mammoth fossils from the Interior', *South Australian Register*, 4 November 1892, 5; Anon., 'Mammoth fossils from the Interior', *Adelaide Observer*, 5 November 1892, 31.

their audiences, the past is 'a story of different worlds as much as different beings'.

As Ward, a palaeontologist at the University of Washington, explained in an
elegy on a mammoth tooth, this fossil 'told' of a 'recent time when elephants roamed
all the earth'. He envisaged 'a time of great ice sheets strangling the land while our
ancestors struggled to keep our species alive' and he 'imagined the call of distant
mammoths'. The mammoth tooth was 'a faint echo', symbolic of 'how powerful the
pull of the past is'. To Ward and other palaeontologists, 'any piece of the past is a
wedge into our planet's history, a slice of the long ago', any fossil 'one more small cog
that, when meshed with many other palaeontological pieces, builds what we might call
a metaphorical time machine, giving us a peek into time long gone by'.

Fossils and palaeoclimatic data are 'pieces' of 'the jigsaw', which the reconstruction,
diorama or scene makes intelligible.

Fossils and other material remains of the past 'tell'; they 'evoke', 'echo' and stimulate the
d grandparents of the imagination to build scenes, vistas, reconstruct whole 'worlds'. The
small cog provided by John Meldrum meshed later with other evidence from the lake,
which helped scientists articulate 'the theory … that in some far back period there was
a vast lacustrine region in the locality named, and the diprotodon and his kind were
attracted to this green spot and died from want of food'.

The marsupial 'mammoths' of Australian prehistory, Diprotodons were first
discovered by Europeans in 1829 in the fossiliferous Wellington Caves of New South
Wales. They continued to intrigue naturalists at the end of the century, as their foot,
tail and epipubic bones remained elusive, obscuring their habits and nearest living
relatives. Considerable institutional cachet was attached to the promise of a complete
skeleton, unknown in over sixty years.

The specimens at the Black Swan Hotel and Meldrum's description of other,
more complete skeletons on the lake surface away beyond the ranges provided a
'wedge', not just into the planet's history, but into bureaucratic purses, which
understood that the promise offered by the bones could only be realised with an
expensive, administratively and strategically complex expedition to the remote north.
Adelaide, a city state at the heart of a great wilderness, was 'a peculiar and

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9 Anon., 'Royal Society of South Australia', *Advertiser* (Adelaide), 6 September 1893.
unpredictable blend of the deeply conservative and the mildly radical' at the turn of the nineteenth century into the twentieth. Adelaideians, self-consciously liberal, comfortably middle-class and mildly philanthropic, believed in education, having founded both a museum (in 1856, under naturalist curator George Waterhouse) and Australia's third university (in 1874) before they sewered the town.10 Encouraged by the world opened up by Meldrum's Diprotodon jaw, by the promise of wealth, of knowledge and of kudos for the colony's cultural institutions, articles in the Observer and the Register exhorted the museum board to send an excavation team to investigate Lake Mulligan as soon as possible. The newspapers urged that Edward Stirling and the museum's assistant director A H C (Amandus) Zietz 'be laid on their track' with the utmost haste.11

The six chapters in Part Three form a story about a landscape and the way landscapes, landforms and their material remains have been understood. It is a story about bones, about science, scientists and the making of institutional and public knowledge. It describes the discovery and articulation of lost and imagined worlds in Australia's geologically recent past, beginning with the public introduction of the Lake Mulligan-Callabonna Station Diprotodon remains in Adelaide in 1892, described above.

On another level, the lost world is the contemporary geographic or scientific frontier waiting for discovery and enlightenment to turn it into a 'site', as occurred at Lake Mulligan in 1892-4. The site itself may then disappear from scientific consciousness to exemplify at times a different type of lost world. In this sense, the lake has been 'lost' and 'found' many times during its brief intersection with the history of Australian palaeontology. Changing patterns of land-use also make lost worlds, in this case for the social historian or ecologist to collect. Landscape stories like these begin to regenerate 'lost' indigenous, pastoral and intellectual heritages.


11 Anon., 'Mammoth fossils from the Interior', 5.
Chapter VII: The lost worlds of Lake Callabonna, 160,000,000 BP – 1901

Losing Lake Mulligan
On 30 November 1901, Hallam, Lord Tennyson, first Governor of the newly federated South Australia, reserved 'Lake Callabonna', formerly Lake Mulligan, a dry 'lake' south of Lake Eyre on South Australia's arid eastern boundary 'hereto for the purpose of the preservation of Fossils' (Plate 18). The Government Gazette of 5 December proclaimed its boundaries as:

Commencing at a point on the north boundary of pastoral lease No. 644, distant four and a quarter miles from its north-east corner;
thence true north for four miles; thence on a true bearing of 335° for six and a half miles; thence true north for ten and a half miles;
thence on a true bearing of 255° for about ten miles to the east boundary of pastoral lease 73; thence south, south-easterly, and east along the boundaries of pastoral leases to the point of commencement.¹

Feted for nearly a decade for its rich burden of giant, extinct marsupial and bird fossils and the palaeoecological surmises this encouraged, nonetheless the lake had not seen a scientific expedition since the South Australian Museum packed up its boxes, bones and camels in 1895. Its famously 'complete' Diprotodon reconstruction – the expedition's object and prize – was not finished for another six years.

Stirling, in collaboration with Zietz, studied and assembled this skeleton of the rhinoceros-sized browser, the largest species of pouched mammal unearthed in 170 years of Australian vertebrate palaeontology, from a miscellany of Lake Callabonna remains brought to the museum between 1892 and 1895. This composite skeleton was never displayed, as the salt-damaged bones were too fragile to stand their own weight. Instead, the museum preparator Robert Limb performed the Herculean task of reproducing 'every significant bone in plaster', then hand-coloured each to resemble

¹ Government of South Australia, 'Fossil Reserve, Lake Callabonna. Proclamation by His Excellency the Governor in and over the State of South Australia and its Dependencies in the Commonwealth of Australia', Government Gazette, 5 December 1901, 1117: 'By virtue of the provisions of "The Crown Lands Act, 1888," I, the said Governor, with the advice and consent of the Executive Council of the said State, do hereby reserve the Crown lands described in the schedule hereto for the purpose of the preservation of Fossils'.

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bone. The Museum unveiled the cast in 1907, the year after the its jubilee celebrations, and the Diprotodon skeleton graced the foyer for many years (Plate 19).

Lake Callabonna is one of a chain of large salt-pans between Lake Eyre to the northwest and the Flinders Ranges to the south, arcing from Lake Torrens in the west to Lake Frome in the southeast. Stranded beaches and fossil fish, turtles, waterbirds and bivalve shells indicate that formerly it was much larger and intermittently filled with fresh water. From 1840 until roughly 1860, the lakes were understood to be a single giant horseshoe lake and formerly an arm of Spencer Gulf, named 'Lake Torrens' by Edward John Eyre, who travelled in the region in the late 1830s and 1840. From 1860 until 1894 pastoralists knew Lake Callabonna as 'Mulligan Springs', 'Lake Mulligan' or 'Mullachon' after an Aboriginal word for the mound springs on its western side. An Aboriginal stockman, possibly called Jackie Nolan, might have indirectly alerted the Adelaide scientific establishment to its palaeontological riches in 1892 by showing them to the Callabonna Station leaseholder Fred Ragless, or to John Meldrum, who then brought samples to Adelaide.

In mid-1893 E C Stirling moved to rename the lake 'Callabonna' after the creek which sometimes flows into it from the Strzelecki, and from which the sheep station took its name, regarded as more 'euphonious' than the Irish-sounding Mulligan. His offering contributed to a public debate in the Adelaide media about renaming Lake Mulligan, which saw suggestions ranging from 'Lake Stirling', to the light-hearted claim that shedding 'Mulligan' was a pre-emptive move on the part of English settlers to write the Irish out of South Australian history.

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2 The father-son team of A H C and F R Zietz, together with museum taxidermists Otto and Julius Rau, actually assembled the skeleton (Hans Mincham, Vanished Giants of Australia [Adelaide: Rigby, 1967], 47-8).


4 från 1840 until roughly 1860, the lakes were understood to be a single giant horseshoe lake and formerly an arm of Spencer Gulf, named 'Lake Torrens' by Edward John Eyre, who travelled in the region in the late 1830s and 1840. From 1860 until 1894 pastoralists knew Lake Callabonna as 'Mulligan Springs', 'Lake Mulligan' or 'Mullachon' after an Aboriginal word for the mound springs on its western side. An Aboriginal stockman, possibly called Jackie Nolan, might have indirectly alerted the Adelaide scientific establishment to its palaeontological riches in 1892 by showing them to the Callabonna Station leaseholder Fred Ragless, or to John Meldrum, who then brought samples to Adelaide.

5 E C Stirling, Minutes of the South Australian Museum [SAM] Board, 2 February 1894. Geoffrey H Manning (Manning's Place Names of South Australia (Adelaide, 1990), 61) recorded that Mulligan is 'a corruption of the Aboriginal mullachan – "springs of water running". The name "Callabonna" was suggested by Dr Stirling in 1894 who failed to record its meaning'.

6 E C Stirling, 'Lake Mulligan' South Australian Register, 8 August 1893, 7; idem, SAM Minutes, 2 February 1894; idem, 'The recent discovery of fossil remains at Lake Callabonna, South Australia',
In colonial Australia, fossils were part of the capital of the earth. Callabonna's early post-excision history describes an emerging scientific independence in Australia. The importance of material artefacts in the reconstruction of 'the past' demanded a conversation between metropolitan and colonial scientists (Stirling and Zietz), their informants ('Jackie Nolan', Meldrum and the Raglesses) and the dirt itself. This hierarchy of negotiation eventually undermined the authority of the distant metropolis. The roles of patron and client were readjusted. Rationalistic centre-periphery models characterise the colonial knowledge trade as radial and recursive: 'raw' objects and data were passed from wandering colonial informants and naturalists to metropolitan savants and scientists, who transformed it into knowledge and theory which they exported back to the periphery, and so on. Such models often overlook and elide the presence of other centres and other peripheries within and around 'the' metropolis and colonies, neglect the importance of cross-cultural encounters and exchanges, and ignore the nuances of personal, national, intellectual and institutional loyalties and agenda.

Adelaide itself, the undisputed political, intellectual, commercial, administrative and ecclesiastic heart of South Australia, was both metropolis and colony. Furthermore, many 'colonial' naturalists had powerful metropolitan patrons and institutional attachments outside the British intellectual centres of London, Edinburgh and Oxbridge, and were also themselves committed to fostering scientific institutions and societies in the Australian colonies. Edward Stirling, for instance, attended Trinity College, Cambridge from 1865 to 1870, was a member of the Royal College of Surgeons from 1872, elected Fellow in 1877, and received a DSc from

\[ \text{Nature} \ 50(1286), \ 8 \text{August} \ 1893, \ 7; \text{Stirling, 'Lake Mulligan'}, \ 8 \text{August} \ 1893, \ 7; \text{'Hugh Kalyptus', 'Lake Mulligan'}, \ 7 \text{September} \ 1893, \ 7; \text{'Mike Mulligan', 'Lake Mulligan'}, \ 9 \text{September} \ 1893, \ 6; \text{'H Kalyptus', 'Echoes and re-echoes. Lake Mulligan – verses'}, \ 9 \text{September} \ 1893, \ 25. \]  

A group of 'Colonists' suggested the name of the lake be changed to honour Stirling, who responded by suggesting 'Callabonna' instead. A month later 'Hugh Kalyptus' and 'Mike Mulligan' sparred amicably in verse about the derivation of the name 'Mulligan' and its suitability or otherwise as a 'native' – as distinct from an Aboriginal – name. 'Mike Mulligan' added the proposed name change to a long list of grievances that Irish settlers cherished against their English counterparts.

\[ \text{For example, as in George Basalla's seminal article 'The spread of western science', Science 5(3), 1982, 1-16. For an important critique of Basalla as applied to Australian contexts, see Roy MacLeod, 'On visiting the "moving metropolis": Reflections on the architecture of imperial science', Historical Records of Australian Science, 5(3), 1982, 1-16. I have discussed Basalla's and others' models as applied to the Lake Callabonna locality in Kirsty Douglas, 'The Diprotodon's toe: Serendipity, parochialism and the mobilisation of the deep past in colonial South Australia', Melbourne Historical Journal: Proceedings of the Mass Historia Postgraduate Conference, University of Melbourne 2001,} \]
Cambridge in 1910. But he was born in Adelaide and educated there at Saint Peter's College. He returned to South Australia in 1881 after years in the United Kingdom, Iceland and Melbourne, and from 1884 to 1887 he represented North Adelaide in the Legislative Council. He also founded the University of Adelaide medical school.\(^8\) He was director of the South Australian Museum from 1889 to 1913 and was president of the Royal Society of South Australia in 1889.\(^9\) His colonial loyalties, particularly to those institutions he patronised, provided a powerful check or complement to his often quite disparate metropolitan institutional affinities.

Callabonna's geographical inaccessibility and the problems associated with excavation and preservation of the fossils (which still have not been entirely solved) offset to some extent the wealth of its 'veritable necropolis' of giant marsupial bones.\(^10\) A degree of scientific neglect resulted and the physical site has slipped in and out of the palaeontological canon over the last century, subject to the vagaries of climate, economic policy and intellectual fashion: 'The richness of the site was apparent, its palaeontological importance was unquestionable, and its geological significance had been hinted at, but no further studies were conducted there'.\(^11\) Compared to Lake Callabonna, and notwithstanding comparable difficulties of access, the Cainozoic fossil localities of the Lake Eyre basin underwent something of a renaissance from the 1950s-70s, as their place in the global 'jigsaw' of palaeontological knowledge was conceived, investigated and celebrated.\(^12\)

Notions of deep time are conditioned by intellectual, economic, cultural and

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\(^7\) [E S Booth], unpublished TS, Stirling Papers, Anthropology Archive (AA) 309, South Australian Museum, Adelaide (hereafter AA 309, SAM, Adelaide).


geographical circumstance. The importance of the Callabonna site in the 1890s and again in 1953 and in the 1970s hinged on contemporary international, intellectual and climatic contingency: scientific narrative intersects with social and environmental history. Every expedition to Callabonna that has returned with a significant bounty of fossils was undertaken at the tail-end of several years of drought, before the site turned into a rainy quagmire impassable to truck and camel alike, in eerie imitation of the entrapment scenario evoked to explain the presence of so many prehistoric bones. In an article in *Australian Natural History*, Richard Tedford, the American palaeontologist who led an expedition to the lake in 1970, emphasised the serendipitous nature of palaeontological discovery: 'That year was an unusually favourable one … Because of a disastrous drought we found we could drive onto nearly every part of the saline clay lake-bed. (The next year the drought broke and our sites were covered by several feet of water!).'¹³

Scientific work at Lake Callabonna resumed in 1953 when the South Australian Museum persuaded Professor Ruben Stirton, Director of the University of California Museum of Paleontology (UCMP) at Berkeley, to detour to the lake in the course of his search for much older mammalian fossils in Australia. Stirton had received Fulbright funding for himself and a student, Dick Tedford, to investigate possible fossil affinities in Australian Tertiary sediments with the Colombian fauna that had so fascinated him throughout the 1940s.¹⁴ The South Australian Museum agreed to provide vehicles and a preparator, Paul Lawson, if the Berkeley expedition diverted to Lake Callabonna to investigate the status of the site¹⁵ – whether the fossils had eroded away or been silted over as local knowledge insisted – and to establish whether the 1901 boundaries of the Fossil Reserve actually coincided with the location of Stirling's 'necropolis', since 'an aura of mystery began to surround the original sites':

Local property-owners, including the Ragless family [which had held the Callabonna Station lease in the 1890s], believed that the bones once exposed on the lake floor had been covered by silt and were no longer visible. In 1953 our hosts, members of the South

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¹³ Tedford, pers. comm., 20 July 2000; quote from Tedford, 'Diprotodons of Lake Callabonna', 353.
¹⁴ 'Tedford, 'Diprotodons of Lake Callabonna', 352.
Australian museum board, agreed to help us in our search if we would visit Lake Callabonna and try to locate the original excavation sites.\textsuperscript{16}

More importantly for the lake's place in the palaeontological canon, the experience had a profound effect on the young Dick Tedford, who wrote his doctorate on another site visited on that first of many Australian expeditions, but remained fascinated by Callabonna's rich and evocative deep past. In 1973 he wrote judiciously of his younger self that 'It was apparent to me that this unique site would richly repay further work'.\textsuperscript{17} In 2000, his enthusiasm for the site remained undimmed:

The array of fossils in that deposit is really quite incredible and would yield absolutely incredible reconstructions of the palaeoecology, but it's never been done … This area began to bug me because the wealth of fossil material was so incredible, I thought 'surely we should go back there and explore this more widely, besides, Stirling and Zietz have been able to collect a much more diverse fauna than we did … there's quite a diverse kangaroo fauna there, why aren't we seeing that?' We also were aware that Zietz had explored more widely on the lake and found material 'everywhere we went thither' he said! … when the lake surface was dry enough they were able to explore rather widely … So I thought … in 1970, this was between major La Niñas so the lake floor was really dry and we thought, this is an opportunity … That trip really opened my eyes to what was there at Lake Callabonna, and it was mind-boggling.\textsuperscript{18}

Subsequently, the site fell into obscurity again, celebrated but rarely visited, an interesting palaeontological footnote awaiting elucidation, a lingering memory in the specimen drawers and display cabinets of the South Australian Museum.

\textsuperscript{16} The quote is from Tedford, 'Diprotodons of Lake Callabonna', 352-3. Also see Martin Glaessner to R A Stirton, nd (UCMP Collection); Paul Lawson, pers. comm., 19 March 2001; Stirton, 'Digging Down Under', 6-8; R A Stirton, Field journal, 'February 12, 1953 to August 23, 1953, pp 1 to 263', unpublished TS (UCMP Collection), 1 June 1953; Tedford, 'The Stirton years', 39-59.

\textsuperscript{17} Tedford, 'Diprotodons of Lake Callabonna', 353.

\textsuperscript{18} Tedford, pers. comm., 20 July 2000.
What is there

In March country at the northern end of the Flinders Ranges is red and brown, black and grey and blue. It is windy and dirty and frequently dry. One is tempted to label the vegetation tenacious or conversely ephemeral, like the signs of human occupation. Green is as surprising as shelter from the wind or sun. Creek beds tell of other hydrological regimes when rivers flow and the dust turns to mire. Still older stories weather out of blowouts, dunes and the banks of the creeks. The land is saturated with bones: big bones, little bones, new bones, old bones, deep bones, shallow bones. Speaking of bones, the lake, which is still further north and closer to the nation's topographic navel, is not a real lake. It is the bones of a lake. It is not even good sheep country, it is the carcass of a pastoral industry that died of thirst, its corpse mauled by rabbits.

An eyewitness, Harold Fletcher of the Australian Museum, described a cabbalistic, provocative landscape:

At times during the day we had glimpses of the dry lake bed of Lake Callabonna as the track passed no great distance from its southern shore. The dry lake surface with a complete absence of vegetation stretched away to the north … as far as the eye could see. It was completely devoid of vegetation and produced a feeling of gloom and extreme loneliness. There was a complete absence of any movement. Even bird life was practically non-existent, and this introduced a hushed stillness adding an aura of mystery to the desolate countryside … Away in the distance, towards the centre of the lake, a cluster of vegetation was miraged up, seemingly to float in the air.¹⁹

This lake is overwritten by another, gravid with doom, mysticism and mirage, emerging from the author's understanding of an 'empty' landscape and a deeper palaeontological past. But before it was known as a graveyard there were other worlds there: inland sea, horseshoe lake, saltbush plain, swamp, desert, too boggy, too dry, wasteland, midden, refuge, larder. Such stories intersect and inform the lake's

scientific stories. Meaning is as unstable as the lake surface.

The watered inland
There are signs of water everywhere you care to look in the interior, on maps, in atlases, in dry lakes and creek beds, in 'relict' stands of rain-loving flora, in bones, sediments and picture books. Geologists, botanists, zoologists, ecologists, ethnologists, folklorists and Aboriginal people tell many stories about the onset of aridity. Here is one of them.

The Eromanga or Great Australian artesian basin has modern surface expression in the Lake Eyre internal drainage system. Its geological history extends from the Jurassic period, about 160 million years ago, when the centre of the continent began to subside. Gondwana still comprised India, Africa, Madagascar, New Zealand and South America, as well as Australia and Antarctica, but the Mesozoic supercontinent had begun to separate into smaller landmasses. Shallow intracratonic basins fed by river and lake systems developed alongside this rifting process. Giant reptiles lived in the rivers, oceans, lakes, air and on the land. Conifer, cycad and palm forests and fern prairies blanketed the landscape. The first true placental (Eutherian) and marsupial (Metatherian) mammal remains appear in the fossil record during the succeeding Cretaceous period (about 135-65 million years ago).20 (Plate 21)

These lilliputian Mesozoic mammals appear to have diversified and expanded into many of the niches formerly occupied by dinosaurs after the demise of the latter at the end of the Cretaceous. It is their larger Tertiary and Pleistocene inheritors that concern me in this section. So let us zoom in to Panels 5, 6 and 7 from our Hallett Cove diorama of Chapter Four in Part Two, for a possible approximation of the Cainozoic history of central Australia.

Panel 5
During the late Palaeocene in the absence as yet of a circumpolar current, warmer ocean waters and a more temperate climate with seasonally high rainfall surrounded

20 R C Sprigg, 'Geological summary', in A Natural History of the Lake Eyre Region: A Visitor's Guide, eds F J Badman, B K Arnold and S L Bell (Port Augusta: NPWS Northern Consultative Committee, 1991), 11; Rod Wells, email, 5 February 2004. See also Smith, 'Lightning Ridge site', 8; and Arthur White, 'Where to find fossils in Australia', Riversleigh Notes, 45, 2001, 26: The first Cretaceous mammal recovered from Australia was identified by Dr Alex Ritchie of the Australian Museum from an opalised jawbone found at Lightning Ridge in the mid-1980s. Steropodon galmani is a cat-sized monotreme which inhabited central Australia at least 100 million years ago. In 1992 another opalised monotreme jawbone was identified from the same area and named Kollikodon ritchiei.
Australia, despite its southern latitude. As a rift valley began to separate Australia from Antarctica, fluviatile sediments from extensive river systems accumulated within the saucer-like intracratonic depression known today as the Lake Eyre basin. Pollen and plant fossils suggest that closed canopy, cool temperate rainforest, akin to that which survives in Chile and Tasmania today, flanked these rivers, dominated by *Nothofagus* (southern beech), *Araucaria* and celery-top pine.21

The faunas of this period are very poorly known. The mammalian faunas of the succeeding Eocene in Australia remained largely unknown as well until the early 1980s. Excavations by members of the Queensland and Australian Museums at Murgon in southeastern Queensland revealed a thin band of marsupial teeth and bones laid down in what appears to have been a shallow lake basin estimated at 55 million years ago.22 These animals seem to be allied to South American groups, which suggests a New World origin for Australia's marsupials. Many turtle and crocodile bones, fish, snake, lizard and frog bones, the bones of the world's oldest song birds, one of the oldest bats (*Australonycteris clarkae*), and, controversially, bones with the characteristics of terrestrial placental fauna (*Tingamarra porterorum*) accompany the Eocene marsupial remains.23

At the end of the Eocene, the zone of cool temperate forest stretched from southern South America, through Antarctica, to southeastern Australia, but increasing aridity led to a reduction in fluvial activity. Many modern groups of Australian biota appeared by the succeeding Oligocene epoch.24 Over the next forty million years, as Australia drifted north and parted company with Antarctica, the migration pathways for terrestrial animals terminated, but flowering plants, grasses, birds and mammals radiated and diversified. Late Oligocene and early Miocene sediments record the expansion of plants of the *Myrtaceae* family, among which number the ubiquitous *Eucalyptus* and *Melaleuca*. The replacement of closed canopy conifer and rainforest by eucalyptus, with its accompanying understorey of scleromorphic shrubs, indicates increased aridity.

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21 Wells, 'Palaeogeography', 98-100.
22 Note that the reliability of this date has been questioned (see Chapter Three).
A magnesium-rich 'megalake' occupied much of central Australia during the mid-Tertiary, remnants of which persist in the Lake Eyre basin today.\textsuperscript{25} Climate change and uplift along the Great Divide in the east and along the southern margin of the Lakes Eyre and Callabonna basins led to renewed sedimentation. The first record of abundant grass pollen dates from this period, suggesting grasslands, which could indicate a drying climate. A varied fossil assemblage of diprotodont marsupials in Tasmania dating from about 23 million years ago, the beginning of the Miocene, may indicate their contemporaneous presence in the forests and grasslands of the Lake Eyre basin.\textsuperscript{26}

By the mid-Miocene, lakes and distributary streams dominated the area. The alternation of seasonal wet and dry intervals facilitated savannah grassland and shrubland expansion, home to the tapir-like marsupial herbivores known as palorchestids ('graceful leaper', named for the Greek hero Achilles' closest companion, Palorchestes). Forests with shrubby understorey grew along the permanent streams and lakes, in which abounded 'rayfinned fish, lungfish, chelid turtles, crocodiles and platypus' and estuarine dolphins and porpoises, above which teemed a multitude of birdlife – 'flamingos, ducks, pelicans, cormorants, gulls'. Fossil evidence also suggests a flourishing terrestrial mammalian fauna in the forests, including arboreal species such as gliding and ring-tail possums, burramyids, phalangerids and koalas, while the understorey provided niches for 'the small insectivorous dasyurids, bandicoots, wombats, rat kangaroos and the carnivorous thylacoleonids'.\textsuperscript{27}

Panel 6
A marked cooling at the end of the Miocene preceded warming in the early Pliocene, five million years ago, and cooling in the late Pliocene. Australia moved closer to Asia, facilitating biotic exchange between the two landmasses.\textsuperscript{28}

Four million years ago a warm shallow sea covered low-lying land in southeastern South Australia. Sediments deposited here hardened into a fossiliferous sandstone, which is now exposed as a bluff along the northwestern part of the Hallett Cove Conservation Park. Contemporary sediments in the Lake Eyre basin indicate

\textsuperscript{25} Wells and Callen, \textit{The Lake Eyre Basin}, 6.
\textsuperscript{26} Wells, 'Palaeogeography', 99.
\textsuperscript{27} Wells, 'Palaeogeography', 99-100.
\textsuperscript{28} Wells, 'Palaeogeography', 100.
increased fluvial activity, but as its northward drift continued Australia became drier. Subsequent lacustrine and alluvial deposits show a tendency to increasing salinity and suggest the beginning of a seasonally arid regime. Saline shallow water sediments and gypsum crystallisation extensively overprint fossil evidence of the earlier freshwater lake ecologies. The presence of gypsum in a sediment is diagnostic of a hypersaline lake environment and generally indicates arid-phase geomorphological processes.29

This evidence is reinforced and mirrored by the changing terrestrial fauna and the disappearance of freshwater dolphins. Erimean fossils of the early Pliocene correspond more closely to the warmer, damper middle Miocene assemblage than to the later Pliocene. The latter fossil fauna is dominated by large browsing diprotodontids and the first evidence of large grazing and browsing kangaroos which, even lacking botanical data, suggests the expansion of the open savannah grasslands and shrublands to something more closely resembling the landscapes of the region in the late Holocene, before the introduction of hoofed ungulates approximately 150 years ago.30

Elsewhere in 'South Australia', the present Mount Lofty Ranges were uplifted about two million years ago, initiating a new period of erosion in the 'Adelaide' region and around 'Hallett Cove'. Across much of the rest of the continent, grasslands and eucalypt woodland gradually supplanted the previously abundant rainforests. Grazing mammals diversified, whose ancestors probably appeared in the early Tertiary period, around fifty million years earlier.

Panel 7
The pattern of warming and cooling, wetting and drying, with a tendency to increasing aridity, repeated throughout the late Pliocene and Pleistocene (about two million – 10,000 years ago).31 Lake Eyre basin sediments reflect sea level and temperature fluctuations as the Pleistocene glaciations of Europe and North America swelled and declined according to oscillations of the polar ice caps. Lake full conditions, high stream discharge and marine incursions over the continental shelf appear early in the glacial cycle. Glacial maxima correlate with sea level retreat, dune building, lake-dry

30 Wells, 'Palaeogeography', 101.
31 Wells, 'Palaeogeography', 101.
phases and the deposition of evaporite minerals like gypsum.

The last phase culminated around 25,000 years ago. Reduced precipitation and spring run-off from the east coast highlands made a dust bowl of the interior. Plains of sand blew across the inland to form its characteristic dune systems. Sea level changes sculpted the coastlines as the continental shelf became coastal plain then shallow sea, and plain again. Giant birds and marsupials browsed the forests, grazed the plains and died in the mud of drying lakes. The fluvial and lacustrine faunas of the Pleistocene, which during humid cycles included 'fish, turtles, crocodiles, the aquatic bird life not dissimilar to that found today (eg. pelicans, ducks, cormorants, herons, ibis, spoonbills)', show little change.

In contrast, much of the terrestrial fauna of the period – the large goose-like birds such as Genyornis, giant browsing herbivorous diprotodontid and macropodid (kangaroo) marsupials, and the suite of carnivores, reptilian and marsupial, that probably preyed upon them like the giant lizard, Megalania, the land crocodile, Quinkana, and the marsupial 'lion', Thylacoleo – was extinct well before the last glacial maximum. From around 16,000 to the present, the continent warmed by several degrees. Forest replaced the steppe grassland and open savannah woodland of southeastern Australia. For at least the last forty five thousand years, Aboriginal people have lived in and modified their customs and these landscapes according to the demands of climate and country.

Modern Lake Eyre is the fourth largest terminal lake in the world. Its shoreline is 1400 kilometres long, and at fifteen metres below sea level it is the lowest point on the Australian continent. It is the topographic sump of the Lake Eyre basin internal drainage system. At more than one million square kilometres this covers almost one sixth of Australia. The mean summer maximum in this area of South Australia exceeds 40°C and individual maxima as high as 61°C have been recorded. The region averages only 110-125 millimetres of rainfall every year and annual evaporation exceeds two-and-a-half metres.

The arid landscapes of the basin apparently exceed in dryness even those of the

34 Wells, 'Palaeogeography', 101.
late Pleistocene, when the fossiliferous deposits of Lake Callabonna accumulated. Sparsely vegetated plains and dunefields contrast with salt pans and ephemeral lakes and rivers, along which endures remnant woodland. In years of high rainfall in the catchment areas of the Diamantina, the Georgina and Cooper Creek (respectively in the Northern Territory and western Queensland) as in 1999-2000, the refreshed watercourses flood Lake Eyre and an abundance of fish and waterbirds returns much as in the Plio-Pleistocene, although the crocodiles, flamingos and dolphins are absent. In contrast, terrestrial faunas have undergone a revolution and introduced placental mammals dominate the country, with remnant populations of rabbit bandicoots, native rodents and red kangaroos. The new megafauna are hooved ungulates like horses, cattle, sheep, goats and camels, and the largest carnivores are dogs, cats and foxes, which prey mostly on rabbits.

Such narratives of degeneration are common in accounts of the interior of Australia. The first Australians had particular local versions which explained the presence and shape of particular landforms, fossils or processes. Some of these accounts, such as those of the 'kadimakara', which are giant creatures who came down from the sky to feast on central Australian verdure, dying out as the country dried, were recorded by Lutheran missionaries and ethnologists during the nineteenth century. Other nineteenth-century versions, such as those by Ralph Tate in Part Two, or by E C Stirling, similarly linked the disappearance of the marsupial megafauna to a continent-wide drying, from the tropical paradise of the Diprotodon age to the modern arid and semi-arid landscapes of South Australia. Anecdotal evidence often pointed to post-settlement drying and salination. At the turn of the nineteenth into the twentieth century, the Scottish-born Professor of Geology and Mineralogy at the University of Melbourne, John Walter Gregory, invoked both Aboriginal accounts and contemporary secular science. He famously wrote of a formerly lush 'Dead Heart' of Australia, whose potential might be re-awakened.

35 Wells and Tedford, ‘Sthenurus from Lake Callabonna’, 6.
36 Wells and Callen, The Lake Eyre Basin, 7-8: The headwaters of the northern rivers lie in Queensland, along the west side of the dividing range separating high rainfall coastal drainage from Lake Eyre internal drainage. ‘During normal monsoon seasons in northern Australia the rivers flow southwest into deserts where they are mainly lost to evaporation, with only small amounts of water reaching the lake to produce minor flooding once in 2 to 3 years or more. When the monsoon belt moves further south than usual, floods, at intervals ranging up to about 30 years, sweep through the deserts into Lake Eyre covering the whole of its bed by major fillings to depths of up to 5m. Shingle terraces indicate prehistoric Holocene fillings up to 9m’.
Modern scientific versions involve climatic degeneration from a land of water to a land of dust. They parallel other secular and non-secular stories of ecological decline from a state of pristine, human-less 'nature'. Human agency in the landscape is often represented as negative and destructive, from the debates about causes of the extinction of Pleistocene megafauna to discussion of the limits of agriculture and pastoralism in modern Australia.
Chapter VIII

Finding Lake Mulligan, 14,000 BP – 1892

In 1860, Robert Stuckey, a South Australian pastoralist, reported his discovery of the mound springs at 'Lake Mulligan'. Of course he was not the first to find them. The lake is saturated with human presence through time. Middens containing worked flakes and other stone artefacts, egg shell fragments and bird bones abound on and near the springs. Some of the egg shells have been carbon-dated to between two and three thousand years old.¹ In the 1980s Mike Smith found evidence of occupation in northern Pirlatapa country, in the Strzelecki Desert to the north of the lake, dated to more than 14,000 years ago.² In 1945 Harold Fletcher, curator of vertebrate palaeontology at the Australian Museum, passed over many clay pans in the course of a day searching for Diprotodon remains.³ They 'brought to light discarded or lost aboriginal implements consisting of flaked or chipped knives, scrapers, spear heads and, now and again, stone axes', evidence from the deep past which for Fletcher proved 'that this area of the country, in the past, was inhabited by tribes of aborigines'.⁴ Stuckey reported that local Aboriginal people called the area, 'Mulligan' or 'Mullachon' after the springs.⁵ 'The past' turns out to be shallower than Fletcher might have expected.

Chapter Eight uses three of the lake's many identities to examine, first, indigenous occupation of the Lake Eyre and Flinders Ranges region, both before and during the pastoral era; second, the period of European exploration of Adelaide's immense, unimagined, disappointing hinterland; and third, pastoral expansion north to the Flinders Ranges and beyond, culminating in a brief history of the Ragless family's

¹ Neville Pledge, pers. comm., 27 January 2000; Pledge, 'Fossils of the lake', 66.
³ Fletcher's memoir (Fletcher, 'Delving into the past'), written fifty years after the event in 1996, records the year of the expedition as 1948, but as the following memo demonstrates, he travelled to Lake Callabonna in 1945: 'On Friday next, 1st June, Mr H O Fletcher, Palaeontologist of this Museum, is proceeding to the Lake Callabonna district to do some field collecting for the Museum collections' (A B Walkom, Director Australian Museum to the Secretary, Liquid Fuel Control Board, Sydney, 30 May 1945, Australian Museum Correspondence Item 35/43, Sydney).
⁴ Fletcher, 'Delving into the past', 150-1.
⁵ Manning, Manning's Place Names, 215.
involvement at Callabonna Station (see Plate 22 for a map showing approximate language boundaries in the Flinders Ranges and inland lakes regions).

'Mullachan' or 'mullachon', the title of the first section, are names variously given to explain the Aboriginal derivation of 'Lake Mulligan', 'Mulligan's Lake' and 'Mulligan's Springs' (see, for instance, Stuckey, above). 'Lake Torrens', the title of section two, was the great lake that Edward John Eyre assumed curved north around the Flinders Ranges, in a continuous arc from Spencer Gulf and the modern Lake Torrens in the southwest to the unrecognised Lake Frome in the southeast. 'Lake Mulligan', the title of the third major section in this chapter, is the name pastoralists gave the large salt pan that formed the easternmost shore of Eyre's imaginary arc, before Stirling proposed 'Lake Callabonna', on the dubious grounds of euphony.

Of course there is a degree of caprice in these distinctions, since the first 'pastoral era' in South Australia's north bled into and complemented the early period of exploration from the 1840s-60s, and both the European explorers and pastoralists relied on Aboriginal people for success, or even survival. These same facilitators lived lives beyond the pages of exploration journals, correspondence, memoirs and reports, and did not regard their primary functions as guides or stockmen for the white leaseholders. But the access I have to their lives is textual, and I have relied heavily on accounts drawn from the journals of Eyre and Charles Sturt, on David Horton's excellent Encyclopaedia of Aboriginal Australia, on Peter Austin's 'The last words of Pirlatapa', and on H H Finlayson's The Red Centre: Man and Beast in the Heart of Australia.

Finding 'Mullachon'

'fit emblem of the sterility of the country'

On 4 August 1840 somewhere north of Mt Deception in the Flinders Ranges, the explorer Edward John Eyre, while 'rambling about after turning out the horses' stumbled upon 'a party of native women and children, but could gain no information from them. They would not permit me to come near them, and at last fairly ran away, leaving at their fire two young children who could not escape'. Having by his own

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Edward John Eyre, Journals of Expeditions of Discovery into Central Australia, and Overland from Adelaide to King George's Sound, in the years 1840-1; Sent by the Colonists of South Australia with the Sanction and Support of the Government: Including an Account of the Manners and Customs of the Aborigines and the State of their Relations with Europeans, 2 vols (London: T & W Boone, 1845), vol 1, 88-9.
account stolen some of their precious water stored in two wallaby skin bags, he 'tied a red pocket handkerchief round one of the children, as payment'. The next day, to his surprise and regret he 'found them still remaining ... left by their unnatural or terrified parents without food, and exposed to the inclemency of a cold winter's night'. In 'such difficult circumstances' as he undoubtedly found himself, Eyre decided to leave the children, in the hope that 'the women might have gone for the men and would probably return by evening'. He did not accord this same courtesy to the parents of 'his native boys' Joshuing and Cootachah, collected on an expedition to Melbourne in 1837, or to his companion in the Flinders Ranges, Neramberein, met with along the Murrumbidgee in 1838.7

This first large group of people he met in the Flinders Ranges were Kuyani or Adnyamathanha. These people lived respectively in the west and east of the region bounded by the curve of salt lakes of which Mulligan-Callabonna is the easternmost. The eastern edge of Adnyamathanha land touches the western shore of Lake Mulligan-Callabonna, Eyre's 'Lake Torrens'.8 (Plate 22) Ten days later in the midst of 'barren miserable plains' to the northwest, Eyre met four men in Kuyani territory who 'took to their heels, apparently in great alarm'. He formed a metaphorical identification between these men and their country, 'impoverished and wretched looking' and 'provokingly insensible', reflecting the land they inhabited.9 A month earlier in the south Flinders, his party stumbled upon a lone young Banggarla or Kuyani woman he similarly dismissed as 'miserably thin and squalid, fit emblem of the sterility of the country'.10 (Plate 22)

On 3 August 1845 Charles Sturt and his party stumbled across a sandy lake basin checking their westward passage, which Sturt identified as a northeastern arm of Eyre's 'Lake Torrens'. It was the northeastern shore of modern Lake Blanche. Less than thirty miles separated him from Lake Mulligan-Callabonna. The previous day the explorers advanced unwittingly between those lakes through Pirlatapa country (Plates

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8 David Horton (ed), The Encyclopaedia of Aboriginal Australia, 2 vols (Canberra: Australian Institute of Aboriginal and Torres Strait Islander Studies, 1994, 36, 571, 1015-16.
9 Eyre, Journals of Expeditions, vol 1, 97-8.
10 Eyre, Journals of Expeditions, vol 1, 62.
Its 'most desolate appearance' did not impress him: 'extremely barren, and surface water was very scarce, and the open ground, entirely denuded of timber'. But hitherto 'in a region destitute of inhabitants', it seemed as if the group was 'getting into a more populous district'.

Pirlatapa speakers lived in the country northeast of the northern Flinders Ranges, east almost to Tilcha, incorporating Blanchewater in the northwest, Lakes Blanche and Mulligan-Callabonna, that together formed the northeast corner of Eyre's 'Lake Torrens', south to Wooltana and Hamilton Creek. Around noon, Sturt met a party of about fourteen Aboriginal men. 'From the surprise they exhibited', he surmised that 'they had never seen a white man before'. Likewise Sturt had never encountered Pirlatapa: 'They spoke a language different from any I had ever heard, had lost two of the front teeth of the upper jaw, and had large scars on the breast'.

The Hakluyt Society recently published a transcription of Sturt's previously unpublished field journals of the expedition, the manuscript of which is held in a private collection. Its editor, the Canadian academic Richard Davis, suggested in a footnote that these people were probably Yandruwandha, of the Strzelecki Creek region, but this identification is based on Sturt's observation in manuscript that their language was similar to the Darling River people, at odds with his insistence in the Narrative that their language was 'different from any I had ever heard'. Davis also recorded that Sturt made no mention of the second group in the Narrative, but in fact he mentioned it in both the Narrative and in his weekly letter to his wife, Charlotte. Possibly in the published version, he might have conflated meetings on two successive days with two different groups of people. Equally, Yandruwandha lived generally to the north of the Pirlatapa, just north of Lake Blanche, so it is not unlikely that Sturt should have met with them in country which, for the purpose of simplification, is mapped historically as 'Pirlatapa country'.

11 Peter Austin, 'The last words of Pirlatapa', Pacific Linguistics C (116), Landscape and History: Essays in Honour of Luise A Hercus, 1990, 30; Horton, Encyclopaedia, 871; Norman B Tindale, Aboriginal Tribes of Australia: Their Terrain, Environmental Controls, Distribution, Limits and Proper Names (Canberra: ANU Press, 1974), 217. Tindale added that 'the poor soil of their country, resembling dung ['kuna], was the basis of a derogatory term applied to them by tribes in the Flinders Ranges' ('Jarikuna', 'Yarrikuna').

12 Charles Sturt, Narrative of an Expedition into Central Australia, Performed under the Authority of Her Majesty's Government during the years 1844, 5 and 6: Together with a Notice of the Province of South Australia in 1847, 2 vols and Map (London: T & W Boone, 1849), vol 1, 340-1.

Despite the evidence of disparate customs, appearance, language and 
behaviour, the occasional fleeting recognition of heterogeneity, European explorers 
like Eyre and Sturt often represented the peoples of the desert regions as physically 
and culturally invariable in an unvarying landscape. Their particularity is lost easily 
enough in these accounts. In expedition journals such as Eyre's and Sturt's, prepared 
for publication some years after the journey's end, the faceless, often 
incomprehensible, uncomprehending 'natives' provided human surrogates who 
personified potential or barrenness in the landscape, narrative hooks to give meaning 
to the processes of exploration and discovery, shape and colour to landscape 
description, but who themselves remain elusive. The 'ripples of their experiences' 
disrupt the smoothness of the encounter on the page, but we have to look elsewhere to 
round out the story.  

'you cannot be indifferent to him'

With at least twenty-seven language groups, the Lake Eyre and Tirari Desert regions 
were the pivot of the north-south trade route between the Gulf of Carpentaria and the 
South Coast. In abundant seasons, which might be far apart, large groups of people 
could gather a harvest of birds, fish and grain, exchange ideas and news, hold 
ceremonies and trade. In the more frequent dry periods, they lived in smaller groups, 
gathering at mound springs and wells, using skin water bags to travel. European 
settlers encountered fierce resistance there as elsewhere.

Pastoralists began to appropriate the most arable Pirlatapa and northern 
Adnyamathanha country when John Baker brought cattle to Blanchewater in 1857. In 
1858 the South Australian government granted him a fourteen year lease over 200 
square miles. Some found a kind of refuge at the Lutheran Bethesda Mission at 
Killalpaninna, north of Mulligan-Callabonna and about 65 kilometres east of Lake

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14 See Michael Cathcart ('Uluru' in Words for Country: Landscape and Language in Australia, eds Tim Bonyhady and Tom Griffiths [Sydney: University of New South Wales Press, 2002], 210). Cathcart elegantly described his attempt to resurrect the Aboriginal guide, 'Moses', who took William Gosse to Central Australia in 1873: 'Suppose we try to conjure Moses out of the silence in which white history has engulfed him … We cannot reinstate his individuality. But we can detect the ripples of his experience in the flow of Will's words'.


Eyre, established a decade later and 'a veritable oasis in the wilderness'. For all their efforts to suppress Aboriginal cultural and religious practices, pastors Johann Reuther and Otto Siebert undertook pioneering linguistic and ethnological work while stationed there. Carl Strehlow also spent time at Killalpaninna before his posting to Hermannsburg in 1894. The Killalpaninna mission closed by 1918, following the closure of Lutheran schools in 1917 as an anti-German measure, and its residents dispersed to other areas.

In northeastern South Australia as in other parts of Australia during the nineteenth and twentieth centuries, Aboriginal people and knowledge were integral to exploration and the pastoral industry. As late as 1935, H H Finlayson wrote of the people of central Australia: 'Regard him as you will, the blackfellow bulks large … if you remain long in his country you cannot be indifferent to him, since almost every activity of a white man there depends ultimately for its success on the blackfellow's cooperation'.

For the previous sixty years, disease, disorder and displacement of indigenous communities accompanied European expansion into the arid zone. Pastoralism depended on annexing land with permanent waters, a corollary of which was disenfranchising its indigenous owners. White settlement caused the local extinction of at least six species of native mammal, despite their long adaptation to recurring drought. After favourable seasons in the 1850s and early 1860s, settlers and government grossly overestimated the carrying capacity of the runs. The drought of the mid-sixties shook pastoralists as their stock died in thousands.

Following the decline of customary food sources, the fencing of land and 'reprisals' over stock hunting, Aboriginal people concentrated at stations or missions in

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18 Austin, 'The last words of Pirlatapa', 30-3; Horton, *Encyclopaedia*, 545-6, 706, 871, 942, 988, 1034-5, 1080-1.


20 H H Finlayson, *The Red Centre: Man and Beast in the Heart of Australia* (Sydney: Angus and Robertson, 1935), 68.

the region, like Killalpaninna. But as Frederick Ragless' account of an 'Emu Corroboree' involving about three hundred people held at Callabonna Station during a 'good season' in the 1880s attests, many of them stayed close to the land with which they identified so closely.22

**Finding 'Lake Torrens'**

*The inland sea and the horseshoe lake*

As we approached the end of our railway journey … we received the lugubrious sympathy of residents along the line … The assertions made to us as to the fatal fury of the heat, the delicacy of the fragile camel, and the appalling scarcity of water, as well as the warnings to beware of the fate of some early explorers in the Lake Eyre basin, suggested a fresh explanation of the Kadimakara legend. Might it not be an allegory on the experiences of Sturt and the tragic fate of Burke and Wills?23

The people of the arid zone knew their country, watched the weather, husbanded scanty resources, dug and maintained wells and waterways to facilitate movement across the great highway of South Australia, framed a knowledge system by which they understood the land and seasons. Lake Callabonna belonged to the Pirlatapa. Its mound springs provided water, birds and shellfish. Its people provided a structure for understanding its land and water forms.

The first European interlopers did not know the country at all well. Motivated by a combination of economic necessity, curiosity, fame, patriotism and optimism, they set off to explore and conquer a continent. Their expeditions were heroic rather than practical, requiring vast amounts of water, protein and horsepower and a degree of local knowledge that would have made exploration redundant. The local knowledge they did have was borrowed.

Superficial similarity often obscures fundamental cultural difference – witness the very different uses for iron nails by Aborigines (as points or weapons) and English (to hold pieces of wood together) and their intersection as gifts or objects of trade.24 A

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23 Gregory, *The Dead Heart*, 11-12

24 For example, see T L Mitchell, *Three Expeditions into the Interior of Eastern Australia with*
C (Augustus) Gregory, then an assistant surveyor for the colony of Western Australia, reported on his expedition northward from Perth in 1848 that on the night of 31 October, a party of about thirty Aborigines 'stole our frying-pan to dig a well, but returned it next morning before the theft was discovered'. In another man's shovel; one man's theft is another's reciprocity.

This enduring disorder in gestural systems made for often-disastrous confusion in race relations, as witnessed by the explorer Charles Sturt's bewilderment at the 'murder' of 'the amicable' Captain Barker by Encounter Bay Aborigines in 1830. Sturt could only digest yet another breakdown in communication with recourse to the opacity and treachery of the Australians. In another incident, the fourth surveyor general of New South Wales, Thomas Mitchell, repeatedly encountered members of 'a Darling River tribe' during his expeditions of 1835 and 1836. These meetings became increasingly confrontational, culminating in Mitchell's men shooting several Aboriginal people on the night of 27 May 1836. Mitchell euphemistically labelled this action 'dispersion' and expressed frustration and regret at its 'necessity', blaming both the treachery of the local Aborigines and the temperaments of those of his men who were former convicts.

Blind to the absence of a community of gesture, the explorers overlooked alternative meaning in Aboriginal behaviour. They interpreted the confusion of signs as wilful deception or stupidity. Sometimes it probably was wilful deception. For instance Topar, 'a fine handsome young man, about eighteen years of age, and exceedingly prepossessing in appearance', but 'with very few good qualities', repeatedly if half-heartedly led Sturt's expedition astray in their search for feed and water to the west of the Darling in 1844. Perhaps he felt that the sixteen men, eleven

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28 For example, Mitchell, Three Expeditions, vol 1, 235, 273, 274, 306-7, vol 2, 90-9; Sturt, Two Expeditions, vol 2, 139.

horses, thirty bullocks, two hundred sheep, six dogs, several drays and a cart would do untold damage to the fragile country in their path, trampling the earth, obliterating the pasture, fouling and consuming the waterways, defiling sacred places, oblivious to indigenous niceties and guidelines.30 Alternatively, perhaps he simply wanted to avoid conflict with local people, who might have seen in Sturt's party a challenge to customary rights to country.

Sturt's report suggests the ecological disaster the party created during its six month confinement at Depot Glen (near the modern town of Milparinka, about thirty-five kilometres south-southwest of Tibooburra in the northern Barrier Ranges of New South Wales) might have vindicated Topar's earlier 'treachery'. On Sturt's arrival there on 27 January 1845, he found the scenery 'quite delighted' him.31 By May he reported to his wife Charlotte, in the weekly journal he kept for her, that the 'cattle had consumed all the feed around us, and the view from the camp was one of the most gloomy description'.32 His later depiction in the published Narrative paints an even grimmer picture: 'Our animals had laid the ground bare for miles around the camp, and never came towards it but to drink. The axe had made a broad gap in the line of gum-trees which ornamented the creek, and had destroyed its appearance'.33

Sturt was not oblivious to the disruption: 'I could not but think we were putting the [local Aboriginal people] to great inconvenience by our occupation of this spot.'34 But this awareness did not prevent further intrusion at their second depot at 'Fort Grey'. Here the party built a 'blockade erected of logs … sufficiently large not only to contain the sheep but to give the men plenty of room to move around … on a rising bank on which there were when we came some native huts'.35 The building of the fort suggests that Sturt was aware that the 'great inconvenience' might have been a trigger for violence, also that there might have been more conflict that he was prepared to record.

Perhaps Topar's people sent the young man to minimise the damage. Sturt's

30 Sturt, Narrative of an Expedition, vol 1, 46.
31 Sturt, Narrative of an Expedition, vol 1, 263.
33 Sturt, Narrative of an Expedition, vol 1, 321.
34 Sturt, Narrative of an Expedition, vol 1, 313.
claim that the more senior men, Nadbuck and Toonda, 'had long conversations with Topar before he left the camp to accompany us' reinforces this inference. 36 Certainly, by 1844 the Aborigines of the Darling River were familiar with the requirements of a fully-equipped overlanding expedition. Sturt estimated his party's consumption of water in the Summer of 1844-5 at between 1000 and 1100 gallons a day. 37 Maybe the Williorara (Menindee Lakes) people meant no 'mischief' at all, but were genuinely afraid that harm might befall their ignorant, ungrateful and suspicious guests in the fearful heat of the Barrier Ranges in summer. 38

Sometimes the problem was simply a confusion of signs, made more confusing by wishful thinking. On 11 May 1845, 'an emaciated and elderly man, rather low in stature, and half-dead with hunger and thirst' arrived at Depot Glen. 39 This man 'strongly excited the anticipations' of the party. 'It appeared quite clear' to Sturt 'that he was aware of the existence of large water somewhere or other to the northward and westward'. 40 He might have indicated the existence of Lake Eyre, which Sturt never found. Alternatively, they might have been talking and gesturing altogether at cross purposes. In any case the old man's 'report' galvanised Sturt, reinforcing his sense of predestination and rejuvenating his watery convictions: 'This old man appeared as if sent to cheer us in our lonely confinement, and certainly his information confirms all my own observations and views'. He added that 'from the sameness of the country at different points' they were certainly 'within one hundred and fifty miles of an inland sea' or some other 'very large feature', which 'if it should be a sea … will enable us to make up for past delays'. 41

Months later, disillusioned after lack of feed and water cut short his dash for the centre, the explorer blamed himself 'for having been so credulous, well aware as I was of the exaggerations of the natives, and how little dependence can be placed on what they say'. 42 Still, there persisted a tension between optimism and disappointed

36 Sturt, Narrative of an Expedition, vol 1, 159.
37 Sturt, Journal of the Central Australian Expedition, 44.
38 For example, Sturt, Narrative of an Expedition, vol 1, 159.
39 Sturt, Narrative of an Expedition, vol 1, 315.
40 Sturt, Narrative of an Expedition, vol 1, 318-20; idem, Journal of the Central Australian Expedition, 49, 54.
41 Sturt, Journal of the Central Australian Expedition, 49.
42 Sturt, Narrative of an Expedition, vol 1, 382-3.
reproach in Sturt's dealings with the Aboriginal people he met, his expectations of the country and in his hopes for the inland waters. Borrowed local knowledge was not enough either to convince or to deter him.

'there hangs a veil'

So, well into the middle of the nineteenth century conventional wisdom decreed the existence of an inland sea or great freshwater lake system in the centre of Australia. Barron Field's account in 1825 epitomised the comparative geographical approach which noted the presence of just such large bodies of water in other continents: North America's Great Lakes, the Mediterranean and other inland seas of Eurasia, Africa's Lakes Tchad, Tanganyika and Victoria, South America's great arterial river the Amazon. Even the prediction of a circumpolar sea in the Arctic seemed to lend weight to the notion.

In 1817 John Oxley, the third surveyor general of New South Wales and Thomas Mitchell's predecessor, hypothesised that the Lachlan and Macquarie rivers terminated in vast marshes littoral to an inland sea, his western progress along the Macquarie checked 'on every point from north-west to north-east, among the ocean of reeds which surrounded us'. In 1828, on his first expedition to the Darling, Charles Sturt observed that the migration of 'the different birds which visit the country east of the Darling during the summer, was invariably to the WNW'. During his later residence in South Australia, he observed the 'same kind of birds' arriving 'directly from the north'. He deduced from these patterns that a giant body of fresh or brackish water must lie 'a little to the north of the Tropic', concluding that 'birds which delighted in rich valleys, or kept on lofty hills, surely would not go into deserts'. This was despite having ascertained on his 1828-31 expeditions 'that no sea' indeed 'little water, existed' on the surface of the interior of New South Wales.

The desire to exploit such an important and expected resource as well as to 'open up' land for grazing and agriculture spurred on both privately and publicly-

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43 For the precedent of inland seas and lakes in other New World settings, see Barron Field, 'On the Rivers of New South Wales', in Barron Field, ed., Geographical Memoirs on New South Wales, by Various Hands (London: J Murray, 1825), 300.

44 John Oxley, Journals of Two Expeditions into the Interior of New South Wales (London: John Murray, 1820), 243-4.

45 Sturt, Narrative of an Expedition, vol 1, 62-4.

46 Sturt, Two Expeditions, vol 1, 48.
funded exploration of the 'unknown' middle of the continent from the 1830s. On 29 May 1840, during a lecture at the Adelaide Mechanics Institute, Sturt offered this support to his friend Edward John Eyre's proposed northern exploration, illustrating the intersection of the economic imperative with the explorer's 'noble' lust for geographical knowledge:

The region of discovery was long open to the ambitious, but the energy and perseverance of man has now left but little to be done in that once extensive and honourable field. The shores of every continent have been explored – the centre of every country has been penetrated save that of Australia … but this country, round which a girdle of civilization is forming, is neglected, and its recesses, whether desert or fertile, are unsought and unexplored. What is known of the interior is due rather to private enterprise than to public energy. Hence there is still a field for the ambitious to tread. Over the centre of this mighty continent there hangs a veil which the most enterprising might be proud to raise … I shall envy that man who shall first plant the flag of our native country in the centre of our adopted one. There is not one deed in those days to be compared with it, and to whoever may undertake so praiseworthy and so devoted a task, I wish that success, which Heaven sometimes vouchsafes to those who are actuated by the first of motives – the public good; and the best of principles.47

Later that year the eponymous Mr Eyre was messing about in the western Flinders Ranges, north of the peninsula and south of the lake that came to share his name, with two Aborigines, five Europeans, thirteen horses, two drays, a cart and forty sheep.48 On a previous expedition in 1839 he had spotted 'a very wide shining stripe of something resembling water' on 16 May, 'to the westward and extending as far as the eye could reach to the north'.49 He identified it later as the southeast shore of Lake Torrens. This time, glimpsing its white expanse some forty kilometres to the west, he determined to reach it, hoping that the lake would provide a reliable source of water

47 Eyre, Expeditions of Discovery, vol 1, 8-9.
48 Eyre, Expeditions of Discovery, vol 1, 31-2.
49 Eyre, Autobiographical Narrative, 201.
for the expedition to proceed northward into the heart of the Flinders Ranges which he regarded as the 'stepping-stone to the interior' of South Australia.  

On reaching the edge of the 'lake' on 8 July 1840 with Neramberein, 'the eldest of [his] native boys' he found it 'completely girded by a steep sandy ridge, exactly like the sandy ridges bounding the sea shore'.  

Eyre discovered 'the dry bed of the lake coated completely over with a crust of salt, forming one unbroken sheet of pure white, and glittering brilliantly in the sun'. Despite its crisp and pristine semblance the surface 'yielded to the foot'. Below it, 'the bed of the lake consisted of a soft mud, and the further we advanced … the more boggy it got … I was obliged to return'. Eyre knew the expedition would have to find other sources of fresh water. Moreover to proceed at all the men needed to find a way around the morass of Lake Torrens: 'I could never hope to take my party across the lake, and it was equally evident, that I should not be able to travel around its shores, from the total absence of all fresh water'.  

Eyre's journal reflected a growing despondency which may go some way to explaining why he so readily accepted the northward and eastward continuity of 'Lake Torrens' although he published the journal five years after the experience, so some of his recorded pessimism and dejection may result from hindsight:

Whichever way I turned myself, to the West, to the East, or the North, nothing but difficulties met my view. In one direction was an impracticable lake, skirted by heavy and scrubby sand ridges; in another, a desert of bare and barren plains; and in the third, a range of inhospitable rocks. The very stones lying upon the hills looked like the scorched and withered scoria of a volcanic region; and even the natives … partook of the general misery and wretchedness of the place.  

Recent rain provided enough water for passage across the plain and Eyre and

50 Eyre, Expeditions of Discovery, vol 1, 25-6.
51 Eyre, Expeditions of Discovery, vol 1, 55. Eyre did not name Neramberein in Expeditions of Discovery but in the Autobiographical Narrative of his Australian adventures up to 1839, he explained that the 'elder boy' had been with him two years fewer than Cootachah, the younger.
52 Eyre, Expeditions of Discovery, vol 1, 58.
53 Eyre, Expeditions of Discovery, vol 1, 59.
54 Eyre, Expeditions of Discovery, vol 1, 63.
Neramberein made for a peak in a tumble of hills to the west of the main range expecting to see an end to Lake Torrens and better country to the northwest. They reached it on 12 July. Eyre in his disappointment at seeing only more sparkling white salt pan in the distance named the hill Mount Deception: 'From the top the view was extensive and unsatisfactory. Lake Torrens appearing as large and mysterious as ever … To the north was a low level cheerless waste'. (Plate 23)

Having brought the rest of the party forward to 'Depot Pool', the pair made for a point to the north, hoping to outflank the barrier of 'Lake Torrens'. On 14 August he and Neramberein (still unnamed in the written record) reached the distant and distinct Lake Eyre South, as it is now known (Plate 23). Eyre presumed it formed part of the same large body of water and mud that thwarted his westward passage and 'would be a barrier to all efforts to the north'. Neramberein's opinion is not recorded.

Five years later the explorer described the 'dismal scene' to the north. Upon reaching this lake, 'it proved to be a winding arm of the main lake' – Torrens – 'at first somewhat narrow, but gradually enlarging'. In keeping with 'the dry part of the bed of the main lake', it was coated 'with a very pungent salt, with mud and sand and water intermixed beneath the upper crust'. Ascending a high bank, he had 'a full view of the lake stretching away to the north-east, as far as the eye could reach', appearing about thirty miles broad, and 'still seeming to be bounded on its western shores by a low ridge, or table land, beyond which nothing could be seen. No hills were visible anywhere, nor was there the least vegetation of any kind'.

'Lake Torrens' kept its secrets. 'Lake Eyre', the 'Katitanda' of the Dieri, remained lost. The pair returned to Depot Pool and the party continued to the east. On 27 August they reached 'a very high hill with rather a rounded summit' which Eyre named Mount Serle. From its summit, after a hard climb in 'exceedingly hot' conditions, they looked to the east and Eyre saw his 'worst forebodings' realised 'and

55 Mincham, 'Since Matthew Flinders', 18.
56 Eyre, Expeditions of Discovery, vol 1, 64.
57 Eyre, Expeditions of Discovery, vol 1, 100.
59 Gregory, The Dead Heart, 95; Brian and Barbara Kennedy, Australian Place Names (Sydney: Hodder and Stoughton, 1989), 122.
60 'in accordance with a request made to me before my departure, by the Governor, that I would name some remarkable feature in the country after Mr Serle', Eyre, Expeditions of Discovery, vol 1, 117.
the termination of the expedition:

Our view was then extensive and final … Lake Torrens now faced us to the east, whilst on every side we were hemmed in by a barrier which we could never hope to pass. Our toils and labours and privations, had all been endured to no purpose; and the only alternative left to us would be to return, disappointed and baffled. To the north and north-west the horizon was unbroken to the naked eye … To the north-east … we saw through a break in the hills, a broad glittering belt in appearance, like the bed of a lake, but apparently dry … Connecting the view before me with the fact that on the 14th of August … I had found Lake Torrens turning round to the north-east … I could now no longer doubt that … the glittering belt I now saw to the east, was in fact only an arm of the lake taking the drainage from [the] eastern slopes [of the Flinders].

What they saw was probably Lake Frome, the large and very separate salt lake on the southeastern flank of the Flinders Ranges (Plate 23).

Naming it 'Mount Hopeless' before ever reaching it, Eyre and 'a native boy' – Neramberein or Cootachah – 'steered for a low haycock-like peak' to the northeast. They ascended it on 2 September. The dejected Eyre was unsurprised by a 'cheerless and hopeless' prospect: the lake was 'now visible to the north and to the east'. As he 'had anticipated', they found a view 'both extensive and decisive'. Eyre thought he had 'at last ascertained, beyond all doubt' that the basin of Lake Torrens commenced near the head of Spencer Gulf, followed the course of Flinders range 'bending round its northern extreme to the south-ward', almost isolating 'the island of South Australia, for such I imagine it once to have been'. This view 'closed all my dreams … and put an end to an undertaking from which so much was anticipated'.

Now known as Lakes Blanche and Callabonna, the 'lake', where it was visible, appeared 'as it had ever done' to be nearly thirty miles across, 'and its distance from Mount Hopeless was nearly the same'. Eyre was convinced he had 'observed all around this mountain mass, the appearance of the bed of a large lake, following the general

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course of the ranges on every side'.

'water as blue as indigo and as salt as brine'
The first white man to view Lake Mulligan-Callabonna was programmed by his earlier experiences in the ranges to ignore its particularity. Once again he was deterred from closer investigation by precedent: the nature of the ground near the lake's western arm proved impassable. Horses and equipment sank into the mud of the salt pans which made traversal of the intervening country unfeasible. Given that 'Lake Torrens'
appeared 'nearly similar in its character, and equally impracticable in its eastern as its western arm' and considering the difficulties he encountered 'in ascertaining these points so minutely on the western side', Eyre decided that he 'could not be justified in renewing those risks to the eastward, where the nature and extent of the impediments were so self-evidently the same, and where there was not the slightest hope of any useful result being attained by it'.

Eyre's confident pessimism proved premature. Mulligan-Callabonna, its northeastern sister Lake Blanche, and the land barrier between them eluded his detection. To Eyre, fatigued and despairing of the 'deceptive' country which 'promised' wealth but delivered constant disappointment, they were undoubtedly the continuation of his impassable horseshoe-shaped lake of glittering white mud. Hampered by drays in alternately rugged and marshy country, Eyre left most of the Flinders unexplored, convinced that the region he had discovered was useless and mostly barren, not yet realising that sheep flourish in saltbush country. Aware of the 'extraordinary and deceptive appearances' caused by mirage, he was wary of trusting 'the evidence of vision' when the land promised water.

Three years later, in July 1843, E C Frome, surveyor general of the colony, reached the big salt lake seen by Eyre from Mt Serle (now Lake Frome), but did not travel far enough north to determine its separate identity. Instead he confirmed Eyre's conclusion regarding both the nature of the country and the configuration of 'Lake Torrens'. Again precedent and expectation hampered discovery:

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64 Eyre, Expeditions of Discovery, vol 1, 130.
65 Eyre, Expeditions of Discovery, vol 1, 111-12.
the lurid glare on the horizon … plainly indicated the approach of Lake Torrens, which, from the direction I had followed, I expected to turn about this point … [It] appeared from the high land to be covered with water, studded with islands, and backed on the east by a bold, rocky shore. These appearances were, however, all deceptive – being caused solely by the extraordinary refraction, as on riding to the spot … not a drop of water was to be seen in any direction. The islands turned out to be mere low, sandy ridges, very scantily clothed with stunted scrub … and no distant land appeared … A salt crust was seen at intervals on the surface of the sand at the margin of the Lake, or, as it might be more properly called, the Desert … [Eyre's] eastern arm of Lake Torrens was the sandy desert I had left … I knew it was useless to advance further in the same direction.66

On the afternoon of 28 November 1844, James Poole and John Harris Browne – respectively second-in-command and surgeon on Charles Sturt's Central Australian Expedition of 1844-6 – climbed a sandy ridge and looking west 'saw a sheet of water about a mile and a half in length, in a sandy bed extending to the north, without any visible termination'.67 They had left the main party eight days earlier aiming to 'reach the shores of Lake Torrens, or any body of water of unknown extent' and to endeavour 'to gain every information' possible. In the absence of such a body of water, they were to 'ascertain if a westerly course [was] open' to the party.68 Sturt hoped to find that 'Lake Torrens' bordered an inland sea. (Plate 26)

South of the sandy lake they observed another sheet of water 'in the same kind of bed, connected with the larger one by a dry channel'. Poole surmised that they drained from the 'barren ranges' fifteen to eighteen miles distant to the west. The water was slightly brackish and the two lakes taken together measured about three miles long. Sturt's two officers described the surrounding country as 'barren', 'bearing a most

67 Sturt, Narrative of an Expedition, vol 1, 199.
68 Sturt, Narrative of an Expedition, vol 1, 190-2.
sterile aspect', 'still more barren' and 'bare'. Meanwhile Sturt speculated 'from the high northerly point Mr Poole had gained, that he had either struck the lower part of the basin of Lake Torrens or some similar feature. It was at the same time, however, clear that the country was not favourable for any attempt to penetrate'.

It seems probable that Poole and Browne made their way along Yandama Creek to the southern extension of Lake Mulligan-Callabonna, where it forms an occasional channel into Lake Frome. Close to discovering its secret, the officers 'found the Lake to consist at this part of a chain of lakes, none of them very large, but they could not see very far to the north where in all probability it was broader' (Plate 26). Mr Poole informed Sturt that 'the country was very peculiar as you approached the Lake and that any one looking at it from high ground would take it for the bed of an immense sheet of water'. Rather than investigate the hint provided by the 'chain of lakes' and perhaps find a passage through to the ranges, Sturt, again deceived by the apparent precedent of Eyre's and Frome's experiences, assumed his officers had reached the eastern extension of Lake Torrens and resolved to strike further to the north next time.

On 4 August 1845, nearly eight months after Messrs Browne and the now deceased Poole reached its 'eastern' shore, Sturt and his party again encountered 'Lake Torrens' (Plate 26). Noting in his field journal from the appearance of the countryside on 3 August that 'there can be no doubt but that we are in the immediate neighbourhood of Lake Torrens, altho we have not yet seen it', Sturt reasoned that 'we ought to be on its shores tomorrow'. The next day, as recorded in the published Narrative, they observed 'a sandhill' before them, 'beyond which no land was to be seen, as if the country dipped, and there was a great hollow' (Plate 25). Their further westward progress was checked 'by the intervention of an immense shallow and sandy basin', measuring 'from ten to twelve miles broad'. The basin was 'destitute of water opposite to us', although 'both to the southward and northward' the party saw 'sheets of water as blue as indigo and as salt as brine', and 'fringed round with samphire bushes'. This feature extended to the south 'beyond the range of vision, but turned to the

69 Sturt, Narrative of an Expedition, vol 1, 198-9.
70 Sturt, Narrative of an Expedition, vol 1, 200.
71 Sturt, Journal of the Central Australian Expedition, 42.
72 Davis, The Central Australian Expedition, 217.
westward in a northerly direction, in the shape in which Mr Eyre has laid Lake Torrens down'. The leader was 'exceedingly provoked' to be 'brought up by this sandy & impassable basin', which he had hoped would be filled with water, 'connected with some larger body [of water] to the north'.

Sturt wrote to the long-suffering Charlotte that on attempting to cross the lake, he and Mr Browne 'found it to consist of patches of sand and salt and clay with gypsum'. It was 'exceedingly level and large masses of clay were scattered over it of fantastic shape, the deep furrows in which shewed with what violence the rains must at times fall there'. Similarly, he speculated in his field journal that 'Numerous water courses fall from the Sand hills into the lake, that must pour a great quantity of water into it during heavy rains. The lake must then contain a broad sheet of water'. Notwithstanding this promise of meteoric water, he found it 'impossible to convey in language any idea of the appearance' of the lake and the country round it: 'The desolate barrenness, the dreary monotony, the denuded aspect of this spot is beyond description'.

He abandoned the hope that Eyre's great lake would lead him to the inland sea and accepted his friend's reasoning that South Australia had been in past times an island or peninsula: 'Lake Torrens … was not connected with any internal body of water, but that it owed its existence in former times to Spencer's Gulf'. This time, having spent a day or so in the desert to the north of Callabonna, Sturt and his men had in fact stumbled upon the future Lake Blanche, but without closer investigation, still the horseshoe remained intact.

**The inland lakes**

The gloomy reports of Eyre, Frome and Sturt fuelled the notion that the land beyond the Flinders Ranges was all impassable salt marsh and inhospitable desert. Geographical exploration, as opposed to mineral, waned in the late 1840s and early 50s. A series of fatal and near-fatal incidents and the disappearance of the German explorer Ludwig Leichhardt, together with his entire party, compounded the effects of

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73 Sturt, *Narrative of an Expedition*, vol 1, 343-8.
75 Sturt, *Journal of the Central Australian Expedition*, 60.
the Victorian gold rushes and the welcome discovery of copper in South Australia to divert official funds and public interest from the inland.78

Land and mineral surveying eventually provided the detailed scrutiny required to separate what E C Black called 'this ogre of a lake'. In 1856 while searching unsuccessfully for gold, B H Babbage, son of the British polymath Charles, heard 'from an Aboriginal' of a northern route through Eyre's horseshoe and consequently, in a frivolous moment, 'named the most northerly prominent feature in the Flinders Mount Hopeful, in contraindication to Eyre's Mount Hopeless some thirty kilometres beyond'.79 The Surveyor General's Office frowned upon such high-spirited nomenclature and the following year George Goyder renamed the peak Mt Babbage.

While surveying the country near Blanchewater with J M Painter in 1857 Goyder, the deputy surveyor general, understandably mistook an expanse of flood water for a gigantic freshwater lake which had escaped the notice of both Eyre and Babbage:

we were in latitude 29° 13', and stood upon the margin of Lake Torrens, the waters of which were unmistakably fresh. From the spot where my observations were taken, the lake stretched from fifteen to twenty miles to the north-west, forming a water-horizon extending from north-west-by-west to north-west; the south portion terminated by high land … An extensive bay is formed by this promontory80

By the time a hastily organised expedition led by the surveyor general Henry Freeling made its way north from Adelaide hampered by a wagon-drawn boat, the 'lake' had evaporated along with some of Goyder's credibility. Freeling dismissed his embarrassed deputy's suggestion that the connection of the eastern and western arms of the horseshoe was still open to conjecture.81

79 Mincham, 'Since Matthew Flinders', 24. See also Black, 'The Lake Torrens hoodoo', 47.
80 G M Goyder, 'Northern exploration. Letter from the Hon. the Surveyor-General, enclosing report from Mr Goyder of his expedition into the northern districts of the colony', *Parliamentary Papers of South Australia* 72 (Adelaide: Government Printer, 1857), 2-4.
81 Black, 'The Lake Torrens hoodoo', 47.
**Finding Lake Mulligan**

*The land of plenty*

Two separate expeditions in 1858 succeeded in fragmenting 'Lake Torrens'. The first, initially led by Babbage who was acrimoniously recalled to Adelaide and replaced by P E Warburton, found and crossed the 'land bridge' between Lake Torrens and the larger northern lake. Babbage named this lake Gregory after his second in command, but the South Australian government renamed it Lake Eyre (South). A C Gregory led the other party. He rode south from Cooper Creek between the unnamed Lakes Blanche and Mulligan-Callabonna towards the Flinders Ranges in search of clues to the fate of Leichhardt's second expedition, which had disappeared without trace in the interior nine years earlier.

Between 21 and 25 June 1858 Gregory's party passed, with a lack of due ceremony, 'between the eastern point of Lake Torrens and what has hitherto been considered the eastern arm, but now ascertained to be an independent lake, the space between (about half-a-mile) was level sandy ground, covered with salicornia, without any apparent connecting channel'.

Gregory dismissed this country to the north of the Flinders Ranges with devastating brevity as 'sterile and of little practical value'. The northern and eastern arm of 'Lake Torrens' (later Lakes Blanche and Gregory) was merely 'an expanded continuation of Cooper's Creek', whose 'peculiar structure' rendered it 'improbable that any considerable inland lakes should exist in connection with the known system of waters'. So three-fifths of the way through the century, Mulligan's Lake entered municipal consciousness, just barely, signifying the imperfect triumph of the surveying eye.

Fifteen years after Charles Sturt came his former off-sider, John McDouall

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86 Gregory, 'Expedition in search of Dr Leichhardt', 209.
Stuart. Stuart held high hopes of his 1860 expedition. He reached the geographical centre of the continent, which he calculated as the midpoint on a line drawn from Moreton Bay to Shark Bay, without setting eyes on the fabled inland sea although he found a much anticipated 'land of plenty':

Proceeding steadily northwards, until the country which his previous explorations had rendered familiar was left far behind, on April 23rd the great explorer calmly records in his Journal the following important announcement:– 'To-day I find from my observations of the sun that I am now camped in the CENTRE OF AUSTRALIA'. One of the greatest problems of Australian discovery was solved! The Centre of the continent was reached, and, instead of being an inhospitable desert or an inland sea, it was a splendid grass country through which ran numerous watercourses.87

'Baffled and disappointed' by 'those gloomy and inhospitable regions', Eyre and his contemporaries missed the particularity of Mulligan-Callabonna.88 They also singularly failed to find navigable inland waters, though Sturt, recalling his sickness and despair, labelled the adamantine plains of the Stony Desert an 'iron sea'.89 He crossed it four times, 'a [lonely] ship … a navigator seeking for land, only that we had the disadvantage of an unsteady compass, without any fixed point on which to steer'.90

Even after the efforts of Augustus Gregory, Babbage and Warburton, the lost world of the horseshoe lake died hard. In the prologue of his biography of Gregory, J H L Cumpston summarised contemporary popular wisdom of the mid-twentieth century thus:

The rivers which now drain into the Lake Eyre basin, the Finke, Diamantina and Cooper systems, once reached the sea along the coast of South Australia; but the elevation by earth convulsion of a barrier across their paths produced a system of inland drainage and formed the Lake Eyre basin, which at one time was a continuous

90 Sturt, *Narrative of an Expedition*, vol 1, 375.
horseshoe of lakes round the northern end of Flinders Ranges.\textsuperscript{91}

The found world of the inland lakes and deserts was a cruel joke, the southern continent's sarcastic rejoinder to the economic and symbolic promise held out by conventional geographical wisdom and wishful thinking, epitomised by the inland sea.

One of several optimistic postscripts to the search for Australia's inland sea, the \textit{Canberra Times} banner for 17 May 2000 announced 'HUGE INLAND SEA FOUND!!'. The front page elaborated that 'A massive underground inland sea big enough', at 4200 sydney harbours, 'to supply Perth with water for the next 4000 years', had been discovered 'below the parched West Australian desert' (Plate 27).\textsuperscript{92} Harping on the hydrological irony that the 'long search for a fabled inland sea' had 'ended' with Anaconda Nickel Ltd's discovery in 'one of the driest parts of the continent', the author noted that the reservoir, which extends 700km by 200km under the Officer Basin northeast of Kalgoorlie, appears to range from between 50m and 2000m deep, with an estimated surface area of 200,000 sq km. The article stressed that the 'sea' was the 'major new public asset', the 'resource' and the 'potential benefit' that Sturt and his contemporaries might have expected, although not usefully navigable in his whaleboat. Ultimately, the Australian exception does appear to have proved the rule; the foregone conclusion of the early inland explorers – that inland deltas open into seas and continents have water at their heart – is yet another subtle demonstration of the perverse logic of the land of contrarieties.\textsuperscript{93}

After and despite Eyre and Sturt, on the heels of Stuart came the squatters. They gradually spread out, taking up unsurveyed land by occupational licence until 1851, when the colonial government issued fourteen year pastoral leases. It extended these in 1865 for a further 21 years, with nominal fixed rentals and right of renewal on Crown leased lands.\textsuperscript{94} By the end of 1874, 'all unappropriated lands "situated south of the twenty-sixth parallel of south latitude" – the whole of South Australia' were open

\begin{thebibliography}{9}
\bibitem{91} Cumpston, \textit{Augustus Gregory}, 1. Cumpston's manuscript was written before 1954, the year he died (but was not published until 1972), so predates the widespread academic acceptance of plate tectonic theory. Subsidence and elevation of land, rather than marine transgression, usually accounted for the change through time in the relative positions of land and sea, but mechanisms for such were poorly defined.
\bibitem{92} Anon., 'A giant sea found under WA outback', \textit{Canberra Times}, 17 May 2000, 1; Anon., 'Giant underground sea discovered under parched WA outback', \textit{Canberra Times}, 17 May 2000, 2. A 'sydney harbour' is the measure of water volume in a sea or lake used in the article.
\bibitem{93} Field, \textit{Geographical Memoirs on New South Wales, by Various Hands}, vi.
\end{thebibliography}
Already in 1858, A C Gregory found that his party could proceed from as far north as Mt Hopeless 'by easy stages towards Adelaide, experiencing the greatest hospitality at the stations on our route'. To his surprise, a few days after establishing without fanfare the southeastern boundary of 'Lake Torrens' and the northern limit of Mulligan-Callabonna, on 26 June 'tracks of cattle and horses were observed'. Eight miles beyond Mt Hopeless they 'came to a cattle station which had been lately established by Mr Baker' at Blanchewater. The lakes were well and truly 'found'.

'A solid house of stone'

The Raglesses were a typical South Australian immigrant pastoral family, albeit noted for their fecundity, 'hardyhood and longevity'. John Ragless senior travelled to South Australia in 1838 on the barque Eden, which docked at Holdfast Bay on 24 June. He settled with his wife Elizabeth and their ten surviving children at Pine Forest, now Enfield, near Gepps Cross which was then on Adelaide's northern outskirts.

Their oldest son, also John, rented the Woodman Inn in Grenfell St on arriving in Adelaide. In 1844 he established a horse-gear operated flour mill at Gawler. The same year in August he married Eliza Wilson, an imperturbable sixteen-year-old bonnetmaker from Newry, Ireland. He moved the mill to Gepps Cross and expanded it in partnership with several brothers. Later John junior extended his field of interest to pastoralism. He and brother Richard acquired 'Yalpara Station', 250 square miles of 'waste lands' on the eastern plains of the central Flinders Ranges, eleven miles

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94 Mincham, 'Since Matthew Flinders', 20; Meinig, On the Margins of the Good Earth, 22.
95 Meinig, On the Margins of the Good Earth, 55-6.
96 Gregory, 'Expedition in search of Dr Leichhardt', 208.
97 Gregory, 'Expedition in search of Dr Leichhardt', 207.
98 I am indebted to Maggie Ragless for information concerning the Raglesses. She shared with me her extensive archive of family papers and memorabilia, particularly her transcription of the journal or 'memoir' of F B Ragless (Seventy years ago: The journal of Frederick Brandis Ragless, unpublished MS, [1936]), as well as her comprehensive history of the Raglesses in South Australia, Dust Storms in China Teacups (1988). Hans Mincham, formerly the Information Officer at the South Australian Museum and author of several histories of the Flinders Ranges, also shared his phenomenal knowledge of the region in a conversation in February 2000. Quote is from Ragless, 'Seventy years ago', 1. See also Anon., 'Remarkable record' [Advertiser? (Adelaide)], 3 December 1926 (unprovenanced newspaper clipping, Margaret E Ragless collection): 'Is there another family in South Australia with anything like the record for longevity so proudly claimed by the Ragless brothers and sisters? Eleven of them are in the land of the living and their combined ages represent 791 years, or an average of just on 72 years!'.
100 Ragless, Dust Storms in China Tea Cups, 21.
northeast of present-day Orroroo. Surveyed by Frome in 1843, the jaded Sturt had described it in 1849 as 'barren plain' and 'scrub' and 'low barren hills'.

Frederick Brandis Ragless was born on 27 July 1859, the last of John and Eliza's children to be born at Gepps Cross. The family set off in April the next year in a covered wagon for Yalpara Station. Their journey took two weeks, after which they continued to live in the wagon, because the wattle and daub homestead was too small to house them all. Twelve years later, Fred Ragless left Yalpara for school in Adelaide. From his return he kept records and accounts for all the Ragless stations. He also kept copious diaries and composed descriptive and patriotic poetry.

These diaries later informed his memoir, 'Seventy years ago', from which much of my information on the Ragless pastoral enterprises is drawn. The bulk of the memoir was written in 1936 when he was in his late seventies. He outlined his objective somewhat defensively, as justification of the spirit of pastoral enterprise that drove his activities in the 'wasteland' of 'the country as it is now … 54 years later': 'It would be as well perhaps, before going on with my personal doings, and observations, to give a detailed description of the Callabonna Country, so that any one reading this book and knowing the country as it is now … will not be too ready to condemn those, who put their capital into it, and spent the prime of their lives in developing it'.

Amid debates about the limits of agriculture in the colony, the South Australian government resumed Yalpara in 1874. The Ragless men, undaunted, procured 'Witchelina', sixteen miles from Government Gums (later optimistically re-named Farina) and 'well away from the influence of plough and harrow'. J Ragless and Sons took out 21-year leases from 1877 as the country became available. Witchelina expanded and in good seasons they took advantage of the stock feed further afield.

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101 Ragless, Dust Storms in China Tea Cups, 24-7. For Sturt's notes (presumably derived from Frome or the equally grumpy Eyre, as Sturt did not visit the area) see John Arrowsmith, 'Map of Capt Sturt's route from Adelaide into the centre of Australia, constructed from his original protractions, and other official documents', in Sturt, Narrative of an Expedition. For Frome's route see John Arrowsmith, 'Map of Mr Eyre's routes into Central Australia, and overland from Adelaide to King George's Sound, 1840-1', in Eyre, Expeditions of Discovery.

102 Ragless, Dust Storms in China Tea Cups, 85-8.

103 F B Ragless, 'Seventy years ago', 2-5.

104 For analysis of the arguments between agricultural and pastoral interests about the expansion of the South Australian wheat belt, see Meinig, On the Margins of the Good Earth, 52-61.

105 Anon., 'Remarkable record'.

PART THREE – DIRT, BONES AND THE DIPROTODONS OF LAKE CALLABONNA 217
In September 1881, Frederick, considering himself 'somewhat of importance' as the newest member of J Ragless and Sons, and his older brother Richard Ragless, opened a 100 square mile run just east of Mulligan Springs, 200 miles east of Farina. They travelled from Witchelina with a horse driver and two shepherds, 'taking five horses … two thousand sheep and a dog'.¹⁰⁶ On 15 September they arrived on Lake Mulligan's northern boundary. Here they 'erected a temporary camp, pitched … tents and built brush yards'. For the next three years, they lived as itinerant shepherds, camping on the shifting orange sands and moving frequently. In 1885 they found a rare stony outcrop at a waterhole 'about ten miles up the Callabonna creek' on the eastern shore of the lake. Ragless recorded that, inexplicably, 'the native name for this waterhole was "Nulcobarlow" meaning fat bullock'. They built a six-roomed homestead and several outbuildings from the limestone, close to the creek and surrounded by acacias.¹⁰⁷

During fifteen years there, Frederick Ragless observed that Callabonna Station was 'one vast, and never-ending sea of sand ridges [or dunes], all trending in a north east, and south westerly direction'. Such timber as there was grew on these dunes and 'consisted of pine, mulgar, and needle-wood' which were 'of a more or less stunted description'. Between the dunes 'Salt, cotton and bluebush, grew sparsely' and 'occasionally a single Box tree could be seen growing in the swamps'. But despite the initially bleak, humanless portrait, Ragless' account reveals an older and ongoing human husbandry of a landscape saturated in the remnants of other names (for instance 'Nulcobarlow', 'Callabonna', 'Mulligan') and practices.

Strong 'caingrass' grew on the ridges and in the swamps which 'the natives' collected to grind the seed 'up for food'. More practically for the leaseholder, the long-husbanded land had much to redeem it 'as horse and cattle country':

After Summer rains the grass was a marvellous fattening fodder for all stock as it produced a long succulent leaf, like that of a wheat plant, was a prolific seed bearer, the seed being about the size of a rape-seed … In all seasons, except droughty times there was an abundance of winter and summer grasses … At intervals there are

¹⁰⁷ Ragless, 'Seventy years ago', 4-5.
large caingrass swamps into which the water collects in the wet seasons. The species of caingrass that grows in these swamps reaches a height of five or six feet, horses and cattle are particularly fond of the papyrus like tossel, that contains the seed.108

Aesthetically too, Callabonna Station country had gems to offer. Ragless' memoir is often unambiguously appreciative of the changing face of the country. He recorded riding 'for days through miles of flowering winter herbage, and during early summer, through miles of blazing parakela [parakeelya?]. I have termed it blazing, because it gives that impression, the flower being a bright red'. At the southern end of the run and fed occasionally by the Yandama Creek, 'Lake Warkalilla was perfectly round, over a mile in width, fringed with green box trees and often swarming with wild fowl'.109

Frederick recorded financial success during the middle five years at Callabonna. By 1890 the South Australian government had sunk two of four proposed reservoirs in the narrow space between the lake and the colony's eastern border. Callabonna wool sold well on the London market and lambing increased substantially until 1894.110 But in 'about 1888' he recorded a small event that, according to Ragless family lore, presaged the station's slow ruin as 'the natives caught their first rabbit and brought it to the homestead to enquire … what made it jump!'111 This seems an improbable question from people well-acquainted with many varieties of hopping marsupial, and the oft-repeated story is surely apocryphal. Hans Mincham in 1967 recorded another, more plausible version: In about 1950, Fred Ragless told him that in 1888, an Aboriginal woman 'had come into Callabonna Station with an animal she had never seen before and inquired of the Ragless brothers, "What name this one?"'112

After a brief, unsuccessful stint in the Western Australian goldfields in the latter part of 1894 with his younger brother Hurtle, Fred Ragless returned to Callabonna. Drought and rabbit plagues forced the Ragless brothers to abandon the station in 1899. The leases were cancelled on 27 June 1900. A government caretaker occupied the property until 1911. In 1917 it was incorporated into the Kidman

108 Ragless, 'Seventy years ago', 5.
109 Ragless, 'Seventy years ago', 4; Ragless, *Dust Storms in China Tea Cups*, 92.
110 Ragless, *Dust Storms in China Tea Cups*, 91.
111 Ragless, *Dust Storms in China Tea Cups*, 91.
112 Mincham, *Vanished Giants*, 45.
In about 1940 Fred Ragless discovered that the roof of the Callabonna homestead had been removed. He composed a lament to wasted opportunities and lost youth, in the process taking a certain amount of poetic licence and a few liberties with meter. Tom Trevaill, who with his wife and children successfully bred horses and cattle at Callabonna Station between 1911 and 1917, responded that far from 'pulling any castles down', they had found the homestead very useful and left it in 'perfect condition with wire doors and windows' intact. Nonetheless, Ragless' sense that Callabonna Station had been 'lost' again, like his need to remind his readers of the Ragless pastoral legacy, is understandable:

I went out in the wilderness,
My fortune there to seek,
And pitched my tent and chattels
On the Callabonna Creek.

I built a solid house of stone,
Lived in it fifteen years,
Hoping good times would come,
And fortune, though in arrears.

But Nature's change crept slowly on
And overwhelmed all.
My efforts strong stood not the strain.
I battled for a fall.

My youth was spent in vain attempt
To stem the tide for years,
But, alas, too late I realised
'Twas all as vain as tears.

All I'd built with youthful pride
As though 'twere in a town,

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113 Public Records Office Land Lease Book; Ragless, Dust Storms in China Tea Cups, 94-5.
114 Anon., 'Memories of Callabonna' [Advertiser? (Adelaide)], 1940, unprovenanced newspaper clipping, Margaret E Ragless collection.
The next to own and fail as I'd,
Pulled all my castles down.\textsuperscript{115}

\textsuperscript{115} F B Ragless, 'Old Callabonna homestead', 1940, unprovenanced newspaper clipping, Margaret E Ragless collection.
Chapter IX

'A world previous to ours', 1795-1892

Australian vertebrate palaeontologists have a keen sense of their own disciplinary history. They tend to represent it both teleologically, as a progression from an ill-defined branch of the catholic natural philosophy of the early nineteenth century to the specialist science of the twenty-first, and adversarially, as having 'overcome' the strictures of Church dogma, periodically cooperated with other evolutionary scientists to attempt to quell 'Creation' theorists, and struggled for relevance against the fluctuations of political, economic and intellectual fashion. Accordingly, this chapter begins with a summary of some nineteenth-century scientific attitudes which informed the development of palaeontology. It culminates in a discussion of the scientific discovery and interpretation of several sites canonical in the annals of Australian mammalian palaeontology and their place in the chain of patronage, rivalry and negotiation which led to the manufacture of palaeontological knowledge. Stories about these sites provide some of the foundation myths of the discipline in Australia, notably the identification and naming of the Diprotodon optatum holotype by the great British comparative anatomist Richard Owen in 1838.

In the nineteenth century, the fossil remains of the giant extinct marsupials encroached on discussions about the origin of species, mechanisms for extinction and the antiquity of Aboriginal people.1 As part of the late twentieth-century rehearsal of some of these debates, they have come to epitomise the destructive capacity of human beings in the often emotive, contentious question of the extinction of the Australian Pleistocene megafauna. With this in mind, a word on the sciences of the deep past in nineteenth-century western historical perspective is necessary.

Nineteenth-century distribution studies and the age of the earth

Over the last four decades, historians of geology from J C Greene in The Death of

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1 Among many examples, see Anon., 'Extinct animals of Australia', South Australian Register, 24 May 1893, 4-5; Anon., 'Extinct life in Australia', South Australian Register, 1 July 1893, 4-5; Kathleen G Dugan, 'Darwin and Diprotodon: The Wellington Caves fossils and the law of succession', Proceedings of the Linnean Society of New South Wales 104(4), 1980, 265-72; Gregory, The Dead Heart, 145; A W Howitt and Otto Siebert, 'Two Legends of the Lake Eyre Tribes', Report of the Ninth Meeting of the Australasian Association for the Advancement of Science, Hobart, 1902, 525-32; R Owen, Researches on the Fossil Remains of the Extinct Mammals of Australia (London: J Erxleben, 1877); R L Tate, 'Elementary Geology Lectures: Notes and Sketches', 2 vols (1894?-1901), vol 2, MSS 0016 Ralph Tate – Notebooks, Barr Smith Special Collections, University of Adelaide, 80.
Adam to Martin Rudwick's recent translation and analysis of the palaeontological works of the French comparative anatomist, Georges Cuvier, have tracked what Rudwick has called 'the emergence of a sense of the history of the earth – and specifically a long and complex prehuman geohistory – in the late-eighteenth and early-nineteenth centuries'. From Buffon's 'epochs' to Blumenbach's 'archaeology of the earth' to Georges Cuvier 'bursting the limits of time', evidence for the 'existence of a world [or worlds] previous to ours' was emerging incontrovertibly from the sedimentary record. But fossils proved contentious and it seemed the same 'facts' could be marshalled in the cause of opposing hypotheses, as I began to explain in the discussion of nineteenth-century glacial theory in Chapter Five. The development of glaciology as a discipline covered much the same intellectual ground traversed by those involved in debates about geochronology, palaeontological remains and the origin of species, elaborated below.

At the beginning of the nineteenth century, western European scientific understanding of geological time was an amalgam of two separate and apparently largely irreconcilable traditions: a Judaeo-Christian heritage which postulated a recent, finite age for the Earth, calculated from Biblical chronologies in the Middle Ages to approximately 4000 BC, and Aristotelian-derived Eternalism. The Eternalism of Aristotle postulated that Earth/Nature is a 'primary entity', self-generating, self-sustaining and existing from all time. It found little favour in the Christian west before the eighteenth century, when George Hoggart Toulmin encouraged its revival. In contrast, Biblical scholars believed the Earth and its inhabitants had been created, almost simultaneously, by Divine fiat out of nothing (Special Creation), and that geological and landscape features arose rapidly and catastrophically over a short period.

During the seventeenth and eighteenth centuries, the rise of geological study undermined the scholarly tradition of Biblical literalism. The French naturalist Georges-Louis Leclerc, Compte de Buffon, deduced from experiments with heated

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metal spheres that he needed up to three million years to account for the cooling of the Earth from a molten ball. James Hutton argued in 1795 that the age of the Earth was unfathomable. It showed 'no vestige of a beginning, no prospect of an end'.

The revision or redeployment of broadly-accepted rules governing the genesis and behaviour of the natural world was partly a result of the development and increasing specialisation of geology from the department of natural history known as physical geography and also of discoveries in the New World. But it by no means involved a complete paradigm shift. Early in the nineteenth century, many high-profile geologists accepted that the Earth must be millions of years old.

Debate still raged over mechanisms for change, notably between those who approached the shape of the earth with a steady-state outlook, epitomised by the 'uniformitarian' paradigm delineated in 1830 by Charles Lyell in his *Principles of Geology*, and those like Georges Cuvier, the cleric and geologist William Buckland, and the Swiss naturalist Louis Agassiz who thought that the current shape of the earth's surface was wrought by cyclical 'catastrophes' – sudden cataclysmic events on a global or regional scale, the latest of which they often conflated with the Mosaic account of the Deluge.

For the sake of convenience and risking anachronism, I have used the terms 'catastrophism' and 'uniformitarianism', coined by William Whewell in an 1830 review of *Principles of Geology*, generally to characterise the early to mid-nineteenth-century arguments about geographical and biological changes at the Earth's surface. In 1969 Martin Rudwick pointed out some of the problems inherent to their uncritical use, in a discussion and review of the translation into English by Alberto Carozzi of Agassiz' glacial manifesto *Studies on Glaciers* (1967 [1840]). Rudwick identified the labels as 'a pair of historiographical mill-stones', which unfortunately left the meanings of uniformity and catastrophe too often 'confused and ambiguous'. More seriously, their use implied 'too uncritical an acceptance of the battle-lines that Lyell had drawn', which led to their degeneration into 'Whiggishly applied terms of praise and

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5 Buffetaut, *Vertebrate Palaeontology*, 40-4.
condemnation respectively'. He suggested that historians of science retain the labels 'only for descriptive purposes within the strict historical context in which they were first applied', abandoning them 'altogether as tools for historical analysis'. I have used them sparingly, but for my purposes here they provide a convenient shorthand.

Debate centred broadly on issues arising from distribution studies. These disciplines might now be termed palaeobiogeography – the study of the distribution of fossil flora and fauna across the earth. Unexpected fossil affinities were a sticking point. For example, the presence of the bones of fossil reindeer and fossil elephants – one species known to be cold-loving, the other tropical – in the same strata, or the presence of so-called tropical fossil assemblages in temperate regions puzzled naturalists. They called upon catastrophic flood, rapid climate change, migration, discontinuities in the fossil record, or the inscrutability of God to explain the apparent irregularities. They also keenly contested the association of fossilised human remains and artefacts with these fossils.

These apparently anomalous relationships and other phenomena such as extinction – the disappearance of species that are represented in the fossil record but not found alive anywhere, such as the North American mastodons or the giant South American ground sloths, megatherium and megalonyx – and such cryptic presences in the landscape as the thick layer of sediment known as diluvium or drift which covers much of northern and western Europe – were often explained in terms of the latest of these cyclical catastrophes (a cataclysmic deluge or a sudden Ice Age for instance) or by invoking various mechanisms for gradual climate change across the earth (again including marine transgression or glaciation).

As early as 1796, Georges Cuvier had proved to his own satisfaction the reality of extinction in the fossil record. Following 'scrupulous examination' of skeletons and disarticulated bones he demonstrated persuasively 'by anatomy' that the 'fossil elephant or "mammoth"' is anatomically distinct from both the living species of elephant, the African and the Asian. This served to refute 'any of these explanations' which posited either 'great inundations' to transport elephant bones from tropical regions or a gradually cooling earth which forced heat-loving species from the poles towards the

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Cuvier found that the fossil animals 'differ from the elephant as much as, or more than, the dog differs from the jackal and the hyena'. As the dog tolerates the cold while the others live 'only in the south', Cuvier was prepared to assume an equivalent relationship between his proboscidean fossils and living elephants and rhinoceroses. In a paper to the Institut national, he claimed that fossil evidence suggested powerfully an earlier, prehuman world or 'creation' that had been destroyed by some kind of 'catastrophe'. He questioned how else bones resembling animals which are seen alive 'only in the tropical zone of the Old World' could be found in great numbers in the north of both Eurasia and North America when they 'cannot have belonged to any of the species that live today in those climates', also reasoning that animals as obtrusive as mammoths and mastodons could not possibly exist alive on earth and yet remain unknown to science.10

Although many (but not all) naturalists were prepared to accept the difficulty of hiding a breeding colony of mastodons on an increasingly mapped and populated earth, the situation with respect to flora and marine fossils was more problematic. For example the collections of the Baudin Expedition in Australian waters (1800-4) included samples of the clam *Trigonia* dredged alive from Bass Strait but previously known only from Mesozoic marine sediments in Europe.11 With such discoveries and the presence of living marsupials allied in characteristics with the 'marsupial' fossils of the Oolites and Lias sediments of the Paris Basin, came the long-standing notion of Australia as a land of living fossils.12

W T Bednall wrote in 1877 that the presence in Australia of the clam 'in a living state' added 'another instance in which this great southern island-continent is the

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10 This essay, from which the quotes above are taken, is translated in Rudwick, *Cuvier*, 18-24, from Georges Cuvier, 'Mémoire sur les espèces d'éléphants tant vivantes que fossiles, lu à la séance publique de l'Institute national le 15 germinal, an IV', *Magasin encyclopédique*, 2e année, 3, 440-5. Cuvier listed geographically and climatically diverse fossil localities including 'underground in Siberia, Germany, France, Canada, and even Peru' (Rudwick, *Cuvier*, 21). See also Rudwick's commentary on page 26: 'As an elephant-sized animal quite unlike any living species, [the Megatherium?] was a sensational addition to the growing collection of large vertebrates that – Cuvier claimed – could not plausibly be supposed to be still alive anywhere on earth!'

11 Eg, W T Bednall, 'Australian Trigonias and their distribution', *Transactions and Proceedings and Report of the Philosophical Society of Adelaide, South Australia* 1, 1878; Peron journal.

12 'Oolitic' and 'Liassic' fossils are nineteenth and early-twentieth-century equivalents to today's Triassic and Jurassic Periods.
Cuvier's great rival, the transformist Lamarck championed this idea. Lamarck denied the reality of extinction in the fossil record. He claimed that apparent extinction was in fact an artefact of the adaptation of species to changing conditions. The only true extinctions he ascribed to human activity during historical times. The importance of the Australian record as applied to the 'problem' of the disappearance of species and higher taxa was thus entrenched early in the history of comparative anatomy, evolutionary biology, and palaeontology.

By Cuvier's death in 1832, the dramatic success of four decades of research on fossils had reworked his early demonstration of a single organic revolution into a powerfully heuristic palaeontological synthesis. Charles Lyell, the stratigrapher William Smith and other geologists established that the history of the earth, unimaginably long by the standards of human history, was documented by a thick sequence of slowly deposited layers of sediment. Successive formations demonstrated distinct assemblages of marine and terrestrial fossil species, enabling their widespread identification and correlation. This facilitated the development of a global geological time-scale which relied on the premise that, in the words of the palaeontologist Antoni Hoffman, 'in its broader outlines the history of life had been the same in all parts of the world'. Thus, as with glaciation, the occurrence of such phenomena as the fossil remains of megafauna in the southern hemisphere was a point of great interest and debate, although unlike the glacial debate the question was not so much whether as what kind?

In May 1831 Cuvier's colleague, the Irish naturalist Joseph Pentland, concluded a letter to Roderick Murchison at the Geological Society in London with the request that the geologist let him know 'what fossils you have received from New Holland. I see by the Literary Gazette that a paper on the subject had been read to the

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13 Bednall, 'Australian Trigonias and their distribution', 77.
The paper is probably Thomas Mitchell's 'Account of the limestone caves at Wellington Valley in New South Wales and of the situation near one of them, where fossil bones have been found', which appeared in the *Proceedings of the Geological Society of London* in April 1831. A paper by the cleric J D Lang appeared the same year in the *Edinburgh New Philosophical Journal* announcing the discovery of these same Wellington Caves fossils. The gradual discovery of the nature of Australia's extinct fauna played a part in the elaboration of that precocious and eclectic branch of natural history, distribution studies. It also enabled the correlation of Australian strata with those of the rest of the world.

**The antediluvian Antipodes**

The European intellectual colonisation of and by the antipodes in this emergent metaphysical landscape was well under way by the time Charles Sturt and Thomas Mitchell in the 1820s and 30s traced Australia's landform history in the southeast back to a widespread or universal Deluge. Both explorers invoked a colossal flood to account for particular features of the geomorphology and the distribution of fossil remains in the Murray-Darling basin. The landscape provided elucidation of God's word as drawn from scripture. In its flatness, its 'island-like' chains of hills, its fossiliferous caves and cliffs, its lacustrine and fluvial geomorphology and its swamps and dunefields, the 'impoverished' material culture of its 'primitive' people and its 'anachronistic' flora and fauna, 'page' after page revealed a quality of newness that engaged with guarded contemporary debate regarding the longevity of the earth and the literal interpretation of the bible. According to both explorers, the landscape and its products as a system of signs could be inserted into their common literary, scientific and religious tradition to unlock the geological history of the country.

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Mitchell took an actualist approach. When Oxley, his predecessor as surveyor-general, leading the 'Second Expedition of Discovery', arrived at and named the Wellington Valley in June 1818 he did not imagine he had discovered such fertile ground for the annalists of antediluvian worlds as well as for settlers, sheep and crops (Plate 20). George Ranken, a Bathurst settler, exploring the caves there ten years later, discovered the first evidence that 'at some former period of its history' Australia was inhabited 'by various races of animals, that are either extinct or no longer existing in this part of the world' (Plate 29). J D Lang provided a detailed account of Ranken's discovery in the 'remarkable cave', announced first in the *Sydney Gazette* of 25 May 1830:

On lowering himself down into this third chamber, into which no mortal man had ever entered before ... Mr R observed, to his very great surprise, a piece of bone lying on the floor of the cavern. It struck him at first that it might have belonged to some bush-ranger who had attempted to hide himself in the cave, and had subsequently died; but on a more minute examination, he discovered a vast number of other bones of various sizes, and generally broken, some strewed on the floor of the cave, but the greater number embedded in a sort of reddish indurated clay along its sides. The rope by which he had lowered himself into the cavern had been fixed to what appeared a projecting point of the solid rock, but on its breaking off in consequence of the weight attached to it, it was ascertained to be a large fossil bone – the thigh bone, I conceive, of some quadruped much larger than the ox or buffalo, and probably of the Irish elk, the rhinoceros, or elephant.

The British palaeontologist and comparative anatomist, Richard Owen, later identified the 'thigh bone ... of some quadruped' as the tibiatarsus of an enormous bird, rivalling the moas of New Zealand in size. He eventually named this bird *Dromornis australis*. Palaeo-ornithologists now regard it as a precursor to *Genyornis newtoni*, a Pleistocene

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21 Quotes are from Lang, 'An account of the discovery of bone caves', 365-6.
giant first identified from Lake Callabonna specimens in the 1890s. 22

Mitchell visited the Wellington Valley in late June or early July 1830
accompanied by Ranken, to survey the caves and collect fossils. 23 He recorded in 1839
that the bones suggested powerfully 'a deposition from water' having earlier laid out
his evidence for these and other 'marks of various changes in the relative height of the
sea' on the east coast 'and in the interior'. In a characteristic disclaimer, he added that
he could not 'pretend to account for the phenomena presented by the caverns' and then
proceeded to do so.

He enlisted the 'sediments of mud forming the extensive margins of the
Darling' to show that formerly 'the waters of that spacious basin were of much greater
volume' and hence that the Wellington Caves had probably been 'twice immersed'.
Based on the geological and geomorphic evidence which he laid out in his exploration
journals and field notes, Mitchell hypothesised that the plains of inland New South
Wales 'were formerly arms of the sea: and that inundations of greater height have
twice penetrated into, or filled with water, the subterraneous cavities' of the
Wellington Valley and other caves in the colony. 24

It is not clear whether he thought that the inundations had a direct causal
relationship with the fossil animals found there. But his expeditions took place well
before Agassiz formulated his glacial theory accounting for the surficial deposits of
Western Europe and Mitchell was a disciple of William Buckland's Diluvial theory. In
1830, before venturing to the Wellington Caves fossil site with Ranken, he expressed
his intention of finding 'Antediluvian Remains, like those found by Mr Buckland'. 25 As
late as 1850, heading to the Wellington Valley on a mineralogical survey, he wrote to

22 Rich, 'Priest-geologists and knighted explorers', 20-1; P V Rich, 'Genyornis newtoni, a mihirung', in
Rich and van Tets, eds, Kadimakara, 191-4; Ann Player, 'Julian Tenison Woods, Richard Owen and
ancient Australia', in 'Richard Owen, Thomas Mitchell and Australian science: A commemorative

23 Mitchell records his first visit as early July 1830 (Mitchell Papers, draft of a letter to the Geological
Society dated 2 September 1831). See Pat Vickers-Rich and Neil Archbold for the suggestion that
Mitchell first accompanied Ranken to the caves on 26 June 1830, before returning a week later (P
Vickers-Rich and Neil W Archbold, 'Squatters, priests and professors: A brief history of vertebrate


Richard Owen that "reliquiae diluvianae" shall not be overlooked. In the end, he was forced to overlook *reliquiae diluvianae* after all, as the urgency of his 'mission – and want of assistant hands' and perhaps a gold-fixated colonial government 'would not admit' of extending his researches from the auriferous rocks of the Wellington Valley to the limestone caves again.

In line with Buckland's and Cuvier's theories about successive cataclysmic events separating different faunas representing different 'lost worlds', the Wellington Caves evidence suggested to Mitchell that flooding separated two distinct and unrelated fossil assemblages. The 'operations', or cataclysmic events, appeared to have occurred subsequent to the local extinction 'of the species whose remains are found in the breccia; and previously to the existence, in at least the same districts, of the present species'. Mitchell was even less ambiguous about this intellectual legacy in his field notebook. He wrote that the caves show 'the same proofs of ['the' has been struck out] a deluge, which are found in the Caves of Europe', describing 'a deep deposit of such particles of earth' as could have been easily suspended in muddy water and carried downwards from the surface through fissures.

Citing Mitchell's data, his own observations and contemporary logic, Charles Sturt proved to his satisfaction in 1833 'the comparatively recent appearance above the ocean of the level country' he had charted. By his reading, Australia was the last continent to emerge from the retreat of floodwaters 'which swept the vast accumulation of shells, forming the great fossil bank of the Murray from the northern extremity of the continent, to deposit them where they are'. He concluded that 'the depressed interior' must simultaneously have been covered by this inland sea which 'washed the western base of the dividing ranges'. Most importantly, the discoveries of stratified fossil deposits at the Wellington Caves confirmed the newness of the country and the existence of a 'past world'.

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27 Mitchell to Owen, 5 January 1852, Owen Papers, Mitchell.


29 Mitchell Papers, CY Reel 248, Vol III, Miscellaneous, A 295-3: Draft of paper read to the Geological Society, London, 13 April 1831: 'Account of the limestone caves at Wellington Valley in New South Wales and of the situation near one of them, where fossil bones have been found', written Sydney 14 October 1830. This paper was published in *Proceedings of the Geological Society, London* 1(21), 1831, 321-4.
The close of Sturt’s second volume was therefore an attempt to synthesise the geographic evidence constantly rehearsed in his published narrative for the post-diluvial quality of the eastern Australian landscape. Changes were no accident but the consequence of 'direct agency' as opposed to 'nature herself'. Geological research alone daily revealed more signs of the 'awful catastrophe which so nearly extinguished the human race'. These 'marks' and 'changes' were 'as gleams of sunshine falling upon the pages of that sublime and splendid volume' which hitherto stood 'single and unsupported before mankind'. The 'corroborative testimonies' of God's wrath were not known to 'those who wrote that sacred book' and so 'the discovery of the remains of a past world' must strike Sturt and his readers with the 'truth of that awful event', the Deluge of the Mosaic account.30

The footprint of the Mosaic account was lighter in his later journals of the Central Australian Expedition, in his field journal (see Davis, *The Central Australian Expedition*), in the relatively candid and often despairing weekly journal he wrote to Charlotte while in the field (published in 1984 as *Journal of the Central Australian Expedition*) and in the published version of 1849 (*Narrative of an Expedition into Central Australia*), although his sense of predestination, his appeals to Providence and his conviction of the watery genesis of the central Australian dunefields were undiminished. His accounts at the beginning and end of the 1849 publication of the former shape of Australia, wherein he speculated that the continent was once an archipelago, are attempts at a geological, rather than a biblical, synthesis.

The middle years of the nineteenth century had continued the slow revolution in the investigation by naturalists of changes to the earth's surface. Perhaps in the intervening years Sturt read Lyell's *Principles of Geology* or Charles Darwin's acclaimed third volume of the official narrative of the *Beagle* voyage, reprinted in 1839 as *Journal of Researches*, or Darwin's contributions to the nascent science of geodynamics – the two monographs on island formation which sprang from his observations on the *Beagle voyage*, *Coral Reefs* and *Volcanic Islands*, published in 1842 and 1844 respectively.31 In any case, the work of Darwin or something like it

30 Sturt, *Two Expeditions*, vol 1, xxxv; vol 2, 224-8. Sturt observed fossil-rich cliffs along the Murray in 1829 and masses of oyster shells in the same vicinity on the tops of hills, as well as an interbedded sandstone and clay formation upstream that seemed 'rather the work of art than of nature' (vol 2, 133).

informed Sturt's later accounts of the lost worlds of the interior of Australia. He was certainly no clearer about the mechanism for the floods which 'must have swept' across central and southern Australia to produce the 'unparalleled desert' that nearly killed him but he no longer explicitly identified it in print, even to his wife, with the 'awful event' which 'so nearly extinguished the human race'.

In keeping with Sturt's and Mitchell's theories, George Ranken's discovery of the fossil remains of the Wellington Valley provided an opportunity for J D Lang to bring Australia geologically into line with the Old World with 'another convincing proof of the reality and the universality of the deluge'. Thanks in part to the Wellington Caves fossils, Lang was able to reinscribe supposed signs of youth in the landscape as signs of age comparable with Europe. By analogy with William Buckland's identification of an ancient 'antediluvian hyaena den' at Kirkdale in Yorkshire, Lang surmised that 'this vast island is not of recent or post-diluvian formation, as is generally asserted, without the least shadow of evidence'.

The discovery inspired Lang 'with a powerful motive of gratitude to Divine Providence for that long-forgotten visitation' which, by destroying 'such beasts of prey as the antediluvian inhabitants of the cave at Wellington Valley' – elephant, hippopotamus, Irish elk, hyaena, tiger, rhinoceros – created 'so eligible a place for the residence of man'. It also provoked a lament that 'the interesting youth of Australia' should 'hitherto have been debared, in consequence of their want of instruction in the various branches of Natural History and Natural Philosophy, from prosecuting the numerous and interesting paths of discovery which this vast island presents to every man of science and research'. 32 He hoped that by promoting abroad the natural history of Australia's deep past, he could also further the cause of antipodean universities.

These early British annalists of Australia's former worlds discovered unpeopled geographies in the dirt and rocks. It was not long before related finds of scratched bones, tools and mysterious teeth began to impact on debates about antiquity of human beings and the origins of the Australians and the Tasmanians, which continue or are revisited today. Australia was a fabulous bestiary of anachronistic natural science specimens to hunt, shoot, stuff, dissect and pickle, and when Lang took a package of fossils from the Wellington Caves to Professor Robert Jameson in


32 Quotes are from Lang, 'An account of the discovery of bone caves', 367-8.
Edinburgh in August 1830 it became a scientific necropolis as well, yet another site of transcontinental renown for the investigation and imagination of lost ecologies, like Big Bone Lick in Ohio, Kirkdale in Yorkshire or the Cavern of Lunel in France.33

Several British savants, notably Charles Darwin, Joseph Hooker at Kew, and Richard Owen at the Royal College of Surgeons and later at the Natural History Museum, spent a large part of their professional careers in the consideration and classification of the palaeobotanical, geological and palaeontological remains of the antipodes and fostered wide networks of antipodean collectors and correspondents. In 1833 Charles Lyell referred to the Wellington Caves remains as supporting non-Cuverian principles (notwithstanding the later publications of Charles Sturt and Thomas Mitchell) and the significance of the marsupial nature of the Australian fossil mammal record has been implicated in Darwin's development of the 'law of succession of types' or descent with modification.34

'Herbivorous mammals of such magnitude'

' a Gigantick species of Kangaroo'34

Mitchell sent a second batch of bones to England in September 1831, including a mysterious tusk-like tooth. These, along with 'a copy of the description and some drawings' were intended for Cuvier, 'from a desire to afford some information respecting the fossil remains we have found in New South Wales' and 'in hopes to

33 Respectively, Semonin, American Monster; William Buckland, 'Observations on the Bones of Hyenas and Other Animals in the Cavern of Lunel, near Montpellier and in the Adjacent Strata of Marine Formation', Edinburgh Journal of Science 6, 1827, 242-6; idem, Reliquiae Diluvianae. Pat Vickers-Rich and Neil Archbold dated Lang's departure from Sydney (with Ranken's and possibly some of Mitchell's specimens from the Wellington Caves) and Lang's 'anonymous' letter to the Sydney Gazette (which later formed his contribution to the Edinburgh New Philosophical Journal – see Lang, 'An account of the discovery of bone caves', 364-8) to 14 August 1830. Lang also took with him a manuscript written by Mitchell, initially published under Lang's name, then republished with an apology as 'Additional information illustrative of the natural history of the Australian bone caves and osseous breccia', Edinburgh New Philosophical Journal 10, 1831, 368-71 (in Vickers-Rich and Archbold, 'Squatters, priests and professors', 6).

profit in common with the rest of the world' from the Baron's anatomical wizardry.\textsuperscript{35} Unfortunately, the French naturalist died in 1832 before the bones reached him, but he had previously seen some of Mitchell's drawings.

Both collections found their way to Edinburgh, where they were examined by Jameson, and to London where William Clift, the conservator at the Hunterian Museum of the Royal College of Surgeons, and Pentland, Cuvier's associate, examined them. Pentland also appears to have seen the bones sent by Lang in 1831, which suggests Cuvier probably saw them before he died. Pentland wrote to Roderick Murchison from Paris in mid-1831 that he had 'received some new fossils, from the New Holland Caves. They belong to a Gigantick species of Kangaroo, 1/3 larger than the largest specimens of the largest Macropus of which we possess skeletons – and in all probability to another extinct species – this is the 8\textsuperscript{th} species found in these caverns'.\textsuperscript{36} Between 1831 and 1833 the Irish naturalist published at least three papers on the Australian fossil remains, translated between French, English, and German.\textsuperscript{37}

Mitchell read widely. In 1830 he was able to write of the Wellington Caves fossils that he had 'been much enlightened by the able works of Professor Buckland and M. Cuvier'. He had read enough to remain puzzled: 'still the circumstances of these bones seem to me quite inexplicable … I shall feel highly gratified if these specimens of Fossil bones from this side of the Globe, engage the attention of any such distinguished geologists'.\textsuperscript{38} Pentland's prolific notices suggest that the specimens did indeed generate some interest.

\textsuperscript{35} Mitchell Papers, draft of a letter to the Geological Society dated 2 September 1831.
\textsuperscript{36} Joseph Pentland to Roderick Murchison, 31 [May?] 1831, LDGSL 838/P10/7 (Murchison Papers).
\textsuperscript{38} Mitchell Papers, volume 8, draft of paper appearing in the Proceedings of the Geological Society, London, April 1831, titled 'Account of the limestone caves at Wellington Valley in New South Wales and of the situation near one of them, where fossil bones have been found', dated 14 October 1830, Sydney.
Apparently anticipating Darwin's law of the succession of types, Mitchell mused that the existence of that 'singular animal', the kangaroo, at such an 'early age' in Australia 'may lead us to suppose that the other remains belonged to species never known in other countries – and it is highly interesting to ascertain therefore whether this is the case or to what species of animals such bones belong'. However, in a letter to Richard Owen in January 1843, assuming the Diprotodon to be a gargantuan kangaroo, he clarified his position. It was 'consolatory' to find that the southern continent 'did once support herbivorous animals of such magnitude', in keeping with Eurasia and the New World.

Evidence like Mitchell's, of 'an animal so well provided for a country of burning woods and fallen timber – by its young-protecting pouch and saltatory powers' having 'always belonged to Australia', might have suggested to Darwin the idea of descent with modification. But to Mitchell it suggested the action of providence and the immutability of species which are, in the words of the Melbourne-based German botanist Ferdinand von Mueller, 'clearly defined in nature, all perfect in their organisation, all destined to fulfil by unalterable laws those designs for which the power of our creating God called them into existence'. Momentarily preoccupied by 'the curious gradation of species – and the diminutive character of existing classes' which 'seem to indicate the energies of animal nature here to be on the wane', Mitchell chose to dwell instead on the 'wise provision of providence for the introduction of those other large animals by man's agency – which have been found better suited to his wants'.

On a visit to England in 1838 to oversee the publication of Three Expeditions, Mitchell took further Wellington Caves material and a partial jaw found in the channels of the Darling Downs to Owen whence began their fruitful correspondence. Owen was William Clift's son-in-law and colleague, recently elected the 'Hunterian Professor', and now heir apparent at the Hunterian Museum. The study of Australian

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39 Mitchell Papers, volume 8, 2 September 1831.

40 Quote from Mitchell to Owen, 28 January 1843 [copy], Owen Papers, Mitchell. For a discussion of Darwin's possible use of Australian fossil vertebrate material in the formulation of the law of succession of types, see Dugan, 'Darwin and Diprotodon', 265-72.


42 Mitchell to Owen, 28 January 1843 [copy], Owen Papers, Mitchell.
vertebrate fossils remained a significant component of the rest of the British comparative anatomist's career.43

The first unprepossessing but fateful metropolitan recognition of the nature of Diprotodon – named for its 'two front teeth' – appeared in a letter from Owen which Mitchell reproduced at the end of the second volume of Three Expeditions. The letter is dated 8 May 1838 and differs little in substance from the published version.44

Owen's classification is based on a piece of characteristically inspired deduction by the anatomist who had only 'the anterior extremity of the right ramus, lower jaw, with a single large procumbent incisor' from which to draw his conclusion (Plate 30). Jameson and Clift initially identified the animal as a hippopotamus or dugong; Buckland and J D Lang thought it likely to be a rhinoceros or hippopotamus; Cuvier and Pentland suggested it was a young elephant. Other later suggestions included sloth, tapir, kangaroo, koala, extinct pachyderm, and an 'enormous rodent'.45 The Port Philip-based naturalist, E C Hobson, identified the 'incisor of an enormous rodent' among the remains found at the Lancefield Swamp near Mt Macedon in 1843, which Owen later identified as a Diprotodon tooth. In 1844 Leichhardt took issue with Owen's classification of Darling Downs dental material (which might or might not have been Diprotodon) as belonging to a 'gigantic Pachyderm' allied to the Deinotherium, a genus of extinct proboscidean placental mammals found in sediments from lower Miocene to upper Pleistocene, distantly related to elephants. Leichhardt assumed it was Diprotodon material and insisted it was more closely allied to kangaroos than 'any other animal'.46


46 Leichhardt to Owen, 10 July 1844, M Aurousseau, ed. and tr., The Letters of Ludwig Leichhardt, 3 vols (Cambridge: Cambridge University Press, Hakluyt Society, 1968), vol. II, 770-3. He also discussed similar bones with his brother-in-law, Carl Schmalfuss, in a letter of 14 May 1844, in Aurousseau, The
Owen was the first naturalist to recognise the mystery animal's marsupial affiliations. He outlined his philosophy on comparative anatomy to Roderick Murchison in 1845:

It is only by the knowledge … of existing species that we can possibly arrive at that of the extinct … [We] must not infer from one species of Elephant that another had the same identical kind of food. True; but it is so only by knowing what kind a living species has, that we can know the kind & degree of deviation which accompanies specific distinctions of dental structure in an extinct species.47

His classification was based on a comparison with the wear, position and structure of a wombat tooth and with the teeth of some of the placental mammals to which it had already been assigned. He wrote to Mitchell (Plate 30):

This is the specimen conjectured to have belonged to the Dugong, but the incisor resembles the corresponding tooth of the wombat in its enamelled structure, and position. See Fig. 2, Pl. 49, and a section of the wombat's teeth, in Fig 7, Pl. 48. But it differs in the quadrilateral figure of its transverse section, in which it corresponds with the inferior incisors of the hippopotamus.48

Still, even Owen could not define the fossil's marsupial associations any more precisely, speculating that it might have been a kind of kangaroo, a giant wombat, or even a relative of the koala.

'it may have been a kind of koala'
The next Diprotodon remains to appear on the scene in any quantity came from the Liverpool Plains in New South Wales, and in even greater numbers from the channels of the Upper Condamine River in Queensland's Darling Downs (Plate 20). In 1842 Mitchell told Owen that the bones accompanying his letter included 'the first from [this] locality'. Although 'not satisfactory specimens', Mitchell was anxious that Owen

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47 Richard Owen to Roderick Murchison, 8 February 1845, LDGSL 838/07/6 (Murchison Papers).

48 Mitchell, Three Expeditions, volume 2, 368-9 and plates. See figures 1 and 2, Pl. 49.
'should first hear of them'.

He shipped more Condamine bones the following year 'in charge of my friend Mr Birdwell' which consisted of 'numerous specimens', the 'most interesting' being 'two jaws' and some 'very large bones (of course the most interest'g) next to the teeth and jaws' (although as he noted wryly to Owen 'any fragment may have records of character wholly illegible' to the surveyor-general). He was pleased to report that the specimens seemed to indicate that 'the tusk figured in my travels [the incisor of a Diprotodon] really belonged to a kangaroo, which you once, if I remember, thought it resembled'. From his own examination of the Darling Downs teeth, Mitchell concluded that 'these jaws' so strongly resemble 'those of the macropus [kangaroo genus] that that I can scarcely doubt that we have here evidence of gigantic Kangaroos to which Macropus Atlas and Titan', the giant extinct precursors to modern grey and red kangaroos, 'are but pigmies'.

The amateur geologist, the Reverend W B Clarke, explained in the *Sydney Morning Herald* five years later that, since the Moreton Bay area was 'opened to colonists' in 1842, the bones of 'species of kangaroos and other animals have been frequently dug up' in the Liverpool Plains 'by persons employed in making wells', from depths 'varying from 20 to 100 feet'. The region along the Condamine River and its tributaries was 'very prolific', and it has consequently 'long been an amusement with the gentlemen squatters on Darling Downs to search for relics of the kind' in this area. He wrote to plead with Sydney's public to patronise a new exhibit of a spectacularly complete Diprotodon skeleton found by a Mr Turner in the channel of King Creek, a tributary of the Condamine, on the Darling Downs. The bones in the creek were reportedly so abundant 'that portions of the bottom of it are literally strewed with their fragments, washed from the alluvium of its banks'. Clarke explained that the specimen was more complete than any found to date, and provided answers to outstanding questions about both its size and its marsupial affiliations:

The portions of the skeleton of this individual which are now in Sydney, consist of the head, both femurs, both scapulae, one humerus, several of the ribs, several vertebrae of the neck, of the

49 Mitchell to Owen, 6 April 1842, Owen Papers, Mitchell.
50 Mitchell, *Three Expeditions*, volume 2, 368-9 and plates. See figures 1 and 2, Pl. 49.
51 Mitchell to Owen, 28 January 1843 [copy], Owen Papers, Mitchell.
back, and of the tail: and the size of these bones when compared
with those of the skeletons of living macropidae, will surprise the
beholder.

Ultimately, the skeleton raised as many questions as it solved, particularly
regarding the proportions of the giant marsupial:

If, eventually, after further examination, the conclusions respecting
its Kangaroo-like character should be confirmed, then we must
suppose it to have been certainly not less than from sixteen to
eighteen feet in height; but as there are appearances in the size of
the bones of the extremities, which would lead to the inference that
it was perhaps not of such a character, but of one more resembling
the larger Mammalia, then it may have been a kind of koala, at the
lowest estimate, nearly ten feet high.

A remarkable point concerning its 'fresh condition' on first being disinterred suggested
a recent origin. Its brain 'was in a state to be easily recognised, and traces of blood
vessels in it were distinct', although Clarke added that all this really proved was the
'peculiarly preservative' quality of the soil: 'but it certainly belonged to the present era,
for a unio, a cyclas, and univalve shells of the same species that still inhabit the
Condamine are found in the soil and even attached to the bone'.52

Due to 'unfortunate circumstances', Owen never examined Mr Turner's
Diprotodon. Mitchell in 1849 described Turner as 'a great speculator on the verge of
bankruptcy' who 'imagined' the bones 'were of very great value'. The surveyor lamented
that they 'fell into [Turner's] hands' while Mitchell was in England, as the Moreton
Bay resident 'declined to allow casts to be taken of them' and although he 'did not
positively refuse to allow' Mitchell to take drawings of the specimens on his return to
send to Owen, 'he did not answer my notes – and only called on me when I was not at
home'. The Australian Museum at last succeeded in obtaining a set of casts from the
next man to own the bones – 'very well coloured in imitation of the original' – from
which Mitchell took a sheet of drawings to transmit to the Royal College of
Surgeons.53

52 Quotes above from W B Clarke, 'Fossil bones', *Sydney Morning Herald*, 30 November 1847.
53 Quotes from Mitchell to Owen, [2]? April 1849, Owen Papers, Mitchell.
The founder of the Australian Museum and influential colonial naturalist, Sir William Macleay, explained the fate of Turner and his bones in a letter to Owen of 9 March 1859:

In the year 1845 or 46 a person named Turner who had been resident for many years as Superintendent of a sheep station on the river Condamine brought down to Sydney a large Collection of fossil bones which he said had been collected by himself after various [flashes?] or floods in the Creeks of the River had left them [bare?] and protruding from the sides of the [valleys?]. He exhibited these here preparatory to taking them to Europe, where he expected to make his fortune by their sale. Before he could leave us however he got into debt and was forced to dispose of them for about £100 to a Mr Benjamin Boyd. This gentleman who was a merchant soon after got embarrassed in circumstances left the Colony and was murdered by the Savages of the Island of Guadalcanal. His intention was also to take them to Europe for sale; but he allowed our Museum to take a set of casts of all of them. After his death his brother Mr [Chas?] Boyd sent them to England, but the vessel was totally lost on the Coast of Portugal; and it is generally considered that these interesting fossils are at the bottom of the Ocean, so that all that remains of them available for Science is our Collection of Casts.54

The museum sent Owen casts of the skull and lower jaw of the Diprotodon from the Turner/Boyd collection and had kept a 'near perfect' cast of the under jaw of Zygomaturus. Like Clarke, Macleay speculated on the giant animal's closest affiliations:

Some years ago paying attention to the thick short heavy and clumsy limbs of this Animal I thought it might bear an affinity to Phascolarctos [koala]; but of late I have had opportunity of paying some attention to the Koala and I find it to feed on insects as well as

Eucalyptus leaves, which by the way seem to be the cause of the difficulty of keeping it alive in captivity. But to return to Diprotodon, I am at present convinced that of all known existing Marsupials, it agrees more with the kangaroo family than with any other.\textsuperscript{55}

Both the museum and Owen reaped some more benefits from the King's Creek site. Macleay sent Owen a Zygomaturus skull from 'Mr Isaac, the proprietor of the Station on which is the creek where Mr Turner found his collection of fossils'. But vertebrate palaeontology was far from flourishing in the colonies. He concluded the letter with a plea to Owen for more direction:

You have found as yet in Europe no Wombats or Diprotodons? If you knew how much a few words from you on such subjects are valued here, by those who think of other things besides wool and gold, you would write me more frequently I am sure were it only to tell me what I ought [more particularly?] to search for among these fossils.

The 'expense & trouble of getting these things from the far Interior' was considerable, and pastoralists had other priorities. They often regarded fossils as mere curios and left them to disintegrate, unless suitable rewards were forthcoming. Inaccessibility, ignorance and isolation remains a problem for palaeontologists, but before camels and the railway opened up the inland the difficulty of obtaining specimens from 'remote' locations was incomparably magnified.

\textit{'One incisor of an enormous rodent'}

The marsupial behemoth next troubled naturalists a little closer to a centre of colonial intellectual endeavour in the summer of 1843, when Mr James Patrick Mayne excavated a well in a swamp at near Mt Macedon to water his thirsty cattle (Plate 20). Doctors Edmund Hobson and Augustus Greeves, both recently appointed honorary curators at the museum of the Melbourne Mechanics' Institution, went to the Lancefield Run to investigate Mayne's report and dig up a pile of bones.\textsuperscript{56} Hobson

\textsuperscript{55} Macleay to Owen, 9 March 1858, Owen Papers, Macleay.

described the picturesque swamp, now at the edge of a sports oval and BMX track in the western Victorian town of Lancefield, in a letter to the Van Diemen's Land botanist R C Gunn in January 1845 as 'a large amphitheatre almost surrounded by conical volcanic hills'. Its centre was on 'a much higher plain than its periphery', and on top of the 'little truncated cone' there was a 'marshy looking place covered by a peaty looking vegetation'. This marsh or bog was 'of the extent of about four acres and appears to contain bones at every point' (Plate 31).

He went on to explain a little of the geology of the site and the factors that rendered excavation so difficult, which later resulted in the locality falling from palaeontological favour, despite the apparent promise offered by 'bones at every point'. These factors included a soil with 'much the character of peat' for three or four feet below the surface. Under this lay a bed of gravel 'in which the bones are deposited in vast quantities, but from there being immediately beneath the gravel a bed of firm ferruginous clay, the water is unable to escape'. Consequently 'it is a work of great labour to obtain any bones, and quite impossible to get them without mutilation, owing to the water pouring in to the part dug so fast as to prevent your seeing what you are about'. Hobson finished his account of the swamp with a brief description of the fossils he found: 'Notwithstanding all this, I succeeded in getting one incisor of an enormous Rodent…; with bones of the gigantic Kangaroo and those of some large cursorial bird, probably an Emu'.

Hobson and Greeves disagreed in print on the initial bony exegesis, as evidenced by a snipe on the part of the latter in a letter to the *Port Phillip Patriot and Melbourne Advertiser* on 5 February 1844 which accused Hobson of publishing precipitately (in the 'anonymous' letter to the *Port Phillip Gazette* on 3 February) and forcing Greaves' hand. It is hard to see exactly where they disagreed. Hobson's article, in the form of a letter from which the above extracts derive, was later published

57 Its fall from grace may have been exacerbated by Hobson's early death from tuberculosis in 1848.

58 References from [E C Hobson], ‘Fossil remains’, *Port Phillip Gazette* 6, 3 February 1844, 2; E C Hobson (Port Phillip) to R C Gunn, (Launceston), January 1845, Box 865/2B, Edmund Charles Hobson, Papers, MS8457, La Trobe Collection, State Library of Victoria, Melbourne. Extracts from this letter were reprinted in E C Hobson, ‘On the fossil bones at Mount Macedon – Port Phillip’, *Tasmanian Journal of Natural Science, Agriculture, Statistics &c* 2, 1846, 311.

59 Augustus F A Greeves, Letter to the Editor, dated 3 February, *Port Phillip Patriot and Melbourne Advertiser* 7, 5 February 1844; [Hobson], 'Fossil remains', 2.
in the *Tasmanian Journal of Natural Science* in 1845.\(^{60}\)

The 'Mt. Macedon site' has the distinction of being the third megafaunal site discovered by Europeans in Australia, the first in the Port Phillip district. It might also be the first site discovered containing a species of the birds which the Monash University palaeontologist Patricia Vickers-Rich has nicknamed *mihirung* birds. These are the *mihirung paringmal* or 'giant emus' of the Tjapwurong people of western Victoria. Vickers-Rich suggested that the 'birds as high as mountains' might correspond to the giant flightless birds of which *Genyornis newtoni* is the most recently extinct. She speculated that the stories of the mihirung were evidence not just of the anatomical skills of Aboriginal people who identified the fossils as belonging to giant birds, but that they recalled a time when Tjapwurong and mihirung coexisted in the volcanic plains of Victoria's Western District. Both the mihirung and active volcanism fill out the narratives. Volcanoes have been active in the Western Districts as recently as 3000 years ago.\(^{61}\)

Australia's first scientific journal, the short-lived *Tasmanian Journal of Natural Science, Agriculture, Statistics &c*, published Hobson's findings, often via extracts from letters to Gunn, including one which Gunn admitted that he fabricated in a letter to Hobson in 1847.\(^{62}\) In these letters Hobson mentioned the 'Emus' and 'gigantic birds'. Despite his close acquaintance with Richard Owen (Hobson had studied under Owen and Robert Grant at the Royal College of Surgeons in the 1830s) and the warmth with which they addressed each other in their correspondence, the only specimens from Lancefield to reach England were a few Diprotodon (the 'incisor of an enormous Rodent'), wombat and *Macropus Titan* remains.\(^{63}\)

Hobson neglected to send the bones of the 'large cursorial bird' for formal identification and they disappeared after his death, thereby, at least in the opinion of the Australian historian of science Wayne Orchiston, potentially depriving Lancefield...

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\(^{60}\) E C Hobson, 'Extract from a letter "On some fossil bones discovered at Mount Macedon, Port Phillip"', *Tasmanian Journal of Natural Science, Agriculture, Statistics &c* 2, 1845, 208-10.

\(^{61}\) Rich, 'Genyornis newtoni, a mihirung', 188-94.

\(^{62}\) Letter from R C Gunn (Launceston) to E C Hobson (South Yarra), 3 July 1847, Box 865/2B, Hobson Papers, MS8457, La Trobe Collection: ‘I have *fabricated* an extract from an imaginary letter or yours so as to introduce the two species of Wombat’.

\(^{63}\) For example, see correspondence between E C Hobson (London, Van Diemen's Land and Port Phillip District), and Richard Owen (Royal College of Surgeons, London), 7 December 1836 – 25 May 1845, Box 865/1C, Hobson Papers, MS8457, La Trobe Collection.
of the title of type locality for *Genyornis*. Orchiston and geologists Rob Glenie and R N Miller speculated that the 'emu' Hobson found was in fact *Genyornis*, as the bones of the enormous bird were found at Lancefield during late twentieth-century excavations. It was left to Stirling and Zietz to identify and name *Genyornis* at Lake Callabonna, which thence became the type locality.\(^{64}\) Although, since the bones were lost before anyone other than Hobson examined them, it is possible that they were indeed emu bones as he suggested. Perhaps he simply neglected to send them to Owen because he knew or assumed that 'ordinary' emu bones would be of little interest to the busy comparative anatomist.

Notwithstanding Hobson's assertion that the swamp contained 'bones at every point', the Lancefield site fell into disuse. After Hobson's last visit there in 1848, no bones were discovered during expeditions by William Blandowski in about 1850 and then in 1858 by Frederick McCoy, the recently appointed Professor of Natural Science at the University of Melbourne, and director of the National Museum of Victoria.\(^{65}\) McCoy wrote to Owen that the University was engaged in excavating 'in the Swamps near Mount Macedon' in search of 'some more of the larger Mammalian remains' such as those first sent to him by Hobson. McCoy continued by requesting a cast of Hobson's Diprotodon jaw and incisor, and promised sketches, casts or photographs 'as may best suit the case' if the excavation successfully unearthed more interesting remains.\(^{66}\) It proved very difficult to excavate, as any hole kept filling up with water and the swamp was soon abandoned, relegated to another palaeontological footnote, more interesting for its link with Melbourne favourite son Edmund Charles Hobson than for the bones he found therein.

Hobson was a native-born New South Welshman, born in Parramatta on 10 August 1814, but raised a Van Diemen's-lander from the age of two by his maternal grandparents. He studied medicine under the Colonial Surgeon, Dr James Scott, and

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\(^{64}\) Orchiston, et al, 'A history of nineteenth century investigations', 115. For references by Stirling and Zietz to the discovery and naming of *Genyornis*, see E C Stirling and A H C Zietz, 'Preliminary notes on *Genyornis newtoni*, a new genus and species of fossil struthious bird found at Lake Callabonna', *Transactions of the Royal Society of South Australia*, 20(1), 1896, 171-90; ibid, 'Description of the bones of the leg and foot of *Genyornis newtoni*, a fossil struthious bird from Lake Callabonna', *Transactions of the Royal Society of South Australia*, 20(2), 1896, 191-211; ibid, 'The newly discovered extinct gigantic bird of South Australia', *Ibis*, 7(2), 1896, 430, 593.


\(^{66}\) Frederick McCoy (University of Melbourne) to Richard Owen (Royal College of Surgeons, London), 14 June 1858, Richard Owen Papers, F McCoy, Volume 18, June 1858 – March 1889, Natural History Museum, London (henceforward Owen Papers, McCoy).
became the first Australian to receive a medical degree from the prestigious Royal College of Surgeons, a talented amateur naturalist more famous for his work at the (now) Royal Melbourne Hospital than for his comparative anatomy. He returned to Van Diemen's Land ill in 1839, then moved to the Port Phillip district the next year for its drier climate to minimise the effects of tuberculosis, which eventually killed him at 34. In 1839, he travelled overland with Lady Jane Franklin from Port Phillip to Sydney, and kept a detailed journal, now in the State Library of Victoria. These notes constitute an early natural history survey of the country between Melbourne and the Murray.67 In 1844 he was gazetted to the first Victorian Medical Board.

Declining health forced him to retire to his South Yarra home in 1946, and he died of 'a ruptured blood vessel in the lungs' on 4 March 1848.68 He left a wife, Margaret (née Adamson, of Walbrook), with whom he fell in love and married in 1837 while in England studying under Owen, and two children. His surviving correspondence with Gunn, with Owen and with Margaret, while sometimes barely legible, demonstrates a quick and ambitious mind and a loving husband. He wrote to his wife as to an informed amateur naturalist, with no hint of condescension, and she sketched many of his figures for him, including a Diprotodon skull found at Lancefield. A memorial statue of Hobson was the first public monument erected in Melbourne, in the general cemetery which is now the site of the Flagstaff Gardens.69

The Lancefield Swamp 'site' is now in a laboratory. The palaeontological canon rapidly shifted and the inaccessibility of its fossils made Lancefield scientifically irrelevant. In 1973 the geologist Rob Glenie relocated the site, about one kilometre southwest of the centre of Lancefield township.70 He introduced pumps and with other earth scientists undertook a multidisciplinary project incorporating geology, archaeology and palaeontology between 1974 and 1976. The excavations 'revealed that vast numbers of bones lay buried several metres below the surface of the swamp',71 vindicating Hobson's claim of 'vast quantities' of bones 'at every point'.

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67 E C Hobson, 'Diary of a journey with Lady Franklin's party overland from Melbourne to the Hume River', 1839, Box 25/1, Hobson Papers, MS383, La Trobe Collection.
68 Hobson Papers, 'Guide to papers held in the LaTrobe Library', 1980, MS8457, La Trobe Collection.
69 Letter from George Cooper to Mr Cassells (Elizabeth Street, Melbourne), 20 March 1848, Box 865/2B, Hobson Papers, MS8457, La Trobe Collection. Discussion of how best to memorialise Hobson. Also see Anon., 'Scientific link with early days', Herald, 18 February 1932.
70 Flannery, The Future Eaters, 201.
During the Ash Wednesday bushfires in February 1983, firefighters searching for water located another fossil deposit in the swamp, about a kilometre from the original site. This contained the remains of a much greater variety of species than the Hobson-Glenie site.

Although W B Clarke wrote in 1847 that 'such relics of the former occupants of New Holland may be expected in all places where the physical conditions of the country appear to be of similar kind', these three regions – the Wellington Caves, the Darling Downs and Lancefield Swamp – together with the Liverpool Plains of New South Wales, remained the primary sites for Australian megafaunal remains during the nineteenth century, until the discovery of the Lake Callabonna site in the 1890s.

The Diprotodon's toe

The bone king

Labelled an 'English Cuvier' in the 1840s, 'the most distinguished comparative anatomist of the day' in 1847 and 'the greatest Anatomist of the Age' in 1870, Richard Owen's empire of fossil behemoths now stretched across several continents, geological periods and three orders of the subphylum *vertebrata*. Despite his preoccupation with such exotica as the giant terrestrial, marine and flying 'lizards' found much closer to home in the Sussex Weald, at Stonesfield near Oxford and in the cliffs of Lyme Regis, the Australian mammal remains continued to exert their pull. On 16 July 1846, he laid before the Board of Curators of the Hunterian Museum a report on 'the fossil bones of Quadrupeds recently received from Australia'.

Owen had previously produced a *Catalogue of Fossil Mammalia* incorporating 'figures of some of the fragmentary fossils of gigantic extinct Marsupial Animals in Australia', published in 1845. This led to 'an active search after similar remains, and [to] the transmission to the College, on the parts of Lieut. Col. Sir Thomas Mitchell, Dr Hobson, Dr Leichhardt and George Bennett Esq., of the specimens so collected'.

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72 Clarke, 'Fossil bones'.


He set about selling to the board his plan to 'publish descriptions, with figures of the principal specimens, as a Supplement to the Volume of the Catalogue of Fossils'. Their 'novelty and interest' was such as to encourage him to produce a special report by which he hoped to gratify the gentlemen whose liberality and interest had so enriched the collections of the College.

The material consisted of bones gathered largely from the Wellington Caves (New South Wales), the Darling Downs (Queensland) and 'the District of Melbourne, 80 miles SW of the town of Melbourne' (Lancefield Swamp). Mitchell's contributions came principally from the Wellington Caves and Darling Downs, Hobson's from the Port Phillip District ('District of Melbourne') and Bennett's from the Darling Downs (Plate 20). There were gigantic species of kangaroo, 'a characteristic fragment of the lower jaws of a Wombat of, at least, four times the size' of modern wombats, and most strikingly, extensive remains of 'the still more gigantic extinct pachydermoid Marsupials indicated in the fossil catalogue under the names of Diprotodon and Nototherium'.75 By this time Owen had renamed Diprotodon optatum the less whimsical but geographically evocative Diprotodon australis and the collections contained examples of 'the entire dentition of the lower jaw, in both young & mature individuals', as well as a portion 'of the upper jaw w/ molar teeth & an incisor, nine inches in length & one & a 1/2 inch in breadth' from the Lancefield Swamp (Hobson's 'incisor of an enormous Rodent') and other parts 'strikingly illustrative of the colossal size'.76

The Australian remains were of great interest in their own right, for the 'very remarkable anatomical characters' they preserved, but even more importantly, for their comparative value, or 'the additional illustration which they afford of the geographical distribution of extinct Mammalia'. Found in 'the breccia of bone-caves [and] in fresh-water deposits of, apparently, the post-pliocene, or newer tertiary period', the fossils were referable to the 'formations containing the remains of mammoths, Hyenas, &c, in Europe', and thus were invaluable for transcontinental correlation. Furthermore, the
genera as had been collected up to 1845.

75 Nototherium means 'southern beast'.

76 See Mincham, Vanished Giants, 50-2, for his discussion of the priority of the specific name optatum. Writing to Mitchell in 1838, Owen used only the generic name, Diprotodon, but optatum appeared in Mitchell's appendix of fossil mammalia in volume one of Three Expeditions. Owen later added the specific name australis, and never used any other. It is not known whether Owen or Mitchell added the name optatum, but it was clearly used in the first published reference to the animal.
specimens themselves were mostly 'peculiar in Europe to the Collection of the College', which, together with their 'novelty and rarity', made their publication a priority.77

Owen eventually had his way and produced first an Australian supplement to the mammal catalogue in 1845, and in 1877 his then definitive *Researches on the Fossil Remains of the Extinct Mammals of Australia*. But even by 1877, with a near-complete skeleton available, Diprotodon feet remained elusive, so Owen was compelled to represent his marsupial ankle-deep in grass (Plate 32). Nor had he identified Diprotodon tail bones or epipubic bone, the former suggestive of its closest marsupial relations, the latter conclusive proof that it was marsupial.

*Professor Owen and the not-elephant*

Despite the overwhelming presence of marsupial precursors in the Australian fossil record, the obsession with placental giants persisted. Even Gerard Krefft, the irascible, alcoholic curator of the Australian Museum fossil collections between 1864 and 1874, was not exempt, despite his Darwinist sympathies. In 1869 he recorded his discovery among the Wellington Caves collections of 'A distal or ungual phalanx of some unknown animal, resembling the same bone of a Mylodon', proving to his satisfaction 'the existence in Australia of a large sloth not unlike the South American genus Mylodon'. Curiously, given that the only other known mylodons were also 'austral', he named it *Mylodon (?) australis*.78 The collection also included 'Another much smaller distal phalanx, also covered by a "hood," … but this belongs evidently to either a dog or cat-like creature', in Krefft's opinion not referable to the dingo or any of the known marsupial predators.79 Although Krefft was eager for Owen's contribution, the bones themselves, once again, never reached Owen:

I am anxious to hear from you regarding the strange nail-bones I found with a sort of protective hood over them, not unlike the toes of Mylodon or Megatherium. I also found another large phalanx which if it really is one, must be that of the thumb of some gigantic

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77 Minutes of the Board of Curators, Volume C, 1844-1854, 'Meeting of the Museum Committee on the 16th of July 1846', Archive of the Royal College of Surgeons, London, 128-30.

78 Curator and Secretary [Gerard Krefft], Australian Museum, to the Colonial Secretary [John Robertson], Sydney, 10 May 1869, No 2584, Shelf 173HG 13.3, Australian Museum Library, Sydney (hereafter Australian Museum Library collection).

79 [Krefft] to [Robertson], 10 May 1869, Australian Museum Library collection.
species; of this I shall also prepare a Cast & forward original. I
regret that I have not the specimen at hand to give you a sketch, but
as a Cast will be ready for next mail, it matters not.80

Later in 1870, seeking Owen's support for another expedition to the Wellington
Caves, he wrote that he was 'anxious to continue our exploration & hope to get more
evidence of the Mylodon like animal to which the toes belong which I had
photographed'.81 While promising casts, sketches, photographs and even duplicates
readily enough, especially when asking for Owen's help or approval, Krefft was loathe
to send the British anatomist any actual specimens.

Despite having triumphantly identified the marsupial nature of Diprotodon,
Owen was far from immune to the tendency to fashion elephants from Australian
ancestries and marsupial fossils. As late as the 1840s, lacking a full set of Diprotodon
teeth and an upper jaw, he speculated whether the animal might not be related to a
tapir after all:

Professor Owen observes further, that there are characters of the
jaw which makes the Wombat very nearly resemble the
Diprotodon; yet again, there are others, which show a greater
resemblance to the Kangaroo, but he adds, there are still other
characters that have closer resemblance to the Tapir than to either.82

As reported by W B Clarke, the matter was only resolved in 1847 when Mr Turner's
specimen, which included a full set of teeth and both jaws, reached Sydney.

More embarrassingly, in 1843 Owen announced to the British scientific
establishment with some satisfaction that he had identified the remains of an extinct
elephant in Australia, based on a single tusk sent to him by the Polish explorer Count
Paul Edmund de Strzelecki, from Boree Station on the Darling Downs (Plate 20).83
Belonging as it did unambiguously to an extinct placental pachyderm closely related to
elephants, Owen tentatively named it *Mastodon australis*.84 According to Owen,

80 Krefft to Owen, July 13 1870 [copy], Owen Papers, Krefft.
81 Krefft to Owen, December 1 1870 [copy], Owen Papers, Krefft.
82 Clarke, 'Fossil bones'.
83 Paul Edmund de Strzelecki, *Physical Description of New South Wales and Van Diemen's Land,
accompanied by a Geological Map, Sections and Diagrams, and Figures of the Organic Remains*
84 Richard Owen, 'On the discovery of the remains of a mastodontoid pachyderm in Australia', *Annals*
Strzelecki obtained the bones from a 'Mr Isaacs', who ran a station on the Condamine River – presumably the same Mr Isaac[s] as was proprietor of the run where Mr Turner obtained his ill-fated specimens. Isaac[s] acted 'on behalf of' an Aborigine. Hugh Falconer, a Scottish palaeontologist and botanist and a good friend and supporter of Darwin's, later became embroiled in a brawl with Owen regarding the classification of South American mastodon fossils. It spilled across the Pacific when Falconer questioned Owen's identification of elephant remains from New Guinea and Australia.

Owen's triumph at finding fossil placental megafauna in Australia stemmed from one of his disputes with Darwin, relating to the latter's law of the succession of types, a keynote in Darwin's theory of the origin of species – the observation that individuals inherit many of the characteristics of their parents. For example, marsupials beget marsupials and placental mammals beget placental, and so on. As Darwin somewhat peevishly suggested, it seems Owen's main objection to the 'law' was that he had not thought of it first himself, or more importantly, that Darwin had received the credit of it. The presence of even a single terrestrial placental fossil such as the *Mastodon* in Australian sediments (other than rodents) undermined Darwin's 'law' and promised to vindicate Owen.

Ludwig Leichhardt and Hugh Falconer both questioned the authenticity of the elephant record in Australia, Leichhardt explaining to his brother-in-law Carl Schmalfuss that all the fossil bones he had found in Darling Downs sediments 'belonged to kinds of animals peculiar to Australia, and I doubt that the elephant bones that are alleged to have been found here can really have come from this part of the world'. Charles Darwin 'never could or would believe in' the Australian mastodon.
Owen later conceded that *Mastodon australis* appeared to be so closely related to South American mastodons because it probably was a South American mastodon, as claimed by Falconer in 1863. It may have been a trade item, as Owen himself suggested in 1882.\(^9\)

Owen became very quiet on the matter, but he did not forget it. He was not a field scientist and never visited Australia. Therefore he depended entirely on the reliability of his suppliers.\(^9\) He correctly identified the molar as belonging to an extinct placental pachyderm. His mistake was in his readiness to accept its eastern Australian provenance. Neither was Strzelecki, who supplied the molar, guilty of misinterpretation or misrepresentation. His account of finding the tooth suggests merely that his credulity was at fault, and his generosity unwarranted:

> a molar bone of the Mastodon, similar to the *Mastodon [sic] angustinis*, and provisionally called, by Professor Owen, *Mastodon australis*, and which I bought from a native at Boree, the sheep station of Captain Ryan, through the agency of the overseer of that station [Fred Isaac]. The native, in giving the bone, stated that similar ones, and larger still, might be got further in the interior; but that owing to the hostility of a tribe, upon whose grounds the bones are to be found, it was impossible for him to venture in that time in search for more: as, however, he promised to exert himself at some future period, in order to supply me with some better specimens, I have left a reward with the man second in command of the station, and which was to be given to the native on redeeming his pledge.\(^9\)

In the early 1880s, Owen was again delivered the tusk of what appeared to be an animal closely related to the elephant, discovered by that same Fred N Isaac[s] (deceased), Strzelecki’s facilitator, and presented by his nephew E Thurston Holland,
Esq. Somewhat chastened by his experience forty years earlier, but still hoping for an exception to the law of succession of types, Owen speculated that the proboscidian might present 'a gyrencephalous exception to the characteristic aboriginal Mammalian organisation of that remote southern colony'.

An etymologically-confused and tautological Owen tentatively named it *Notelephas australis*. He hoped that its subsequent history would mimic that of *Diprotodon australis*, which by 'successive confirmations' beginning with 'but a portion of a tusk' in 1838, ultimately established 'the ordinal, generic, and specific characteristics' of the 'previously hugest known Marsupial'. Instead, its history apparently mirrored that of *Mastodon australis*, as *Notelephas* was quietly consigned to the dustbin of palaeontological chimerae, and the southern elephant proved indeed to be a not-elephant.

*how it is that no large digits should occur*

Comparative anatomists required an entire Diprotodon skeleton to establish its affiliations. The discovery of Turner's Darling Downs Diprotodon in the mid-1840s was extremely important in this respect. Hitherto known only by a few scattered teeth and tusks and sections of lower jaw, Turner's skull was 'not only unique but perfect; for the head is nearly complete, with the exceptions of some of the hinder parts'. It exhibited 'all that is necessary for comparison with the Wombat, Tapir, and Kangaroo, and those gentlemen who have examined it, have pronounced it in many regards nearer perhaps to a Kangaroo than to any other known creature'. From their respective dental formulae and 'other reasons' that Clarke regarded as unnecessary to enumerate, the Sydney intelligentsia ruled that the Diprotodon 'must have been in some respects very near a Kangaroo, and if characters may be relied on, certainly marsupial', but as there was also 'a great resemblance' between its teeth and koala teeth only 'the presence of a tail would settle that point at once'.

In contrast to these mid-century speculations, in 1869 Krefft agreed with Owen in classing the gigantic extinct marsupials *Diprotodon, Zygomaturus* and *Nototherium* with the phalangers rather than the kangaroos. As he wrote to John Robertson, the Colonial Secretary, their incisors 'resemble the teeth of the phalanger more than those

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93 Owen, 'Description of portions of a tusk', 779.
94 Owen, 'Description of portions of a tusk', 779-80.
95 Clarke, 'Fossil bones'.
of the kangaroo' and their lower jaws 'are deficient of the wide excavation at the base of the coronoid process so conspicuous in the jaws of all kangaroos'.

Still at question was the nature of Diprotodon feet. The 'missing bones' were a crucial part of the jigsaw. Krefft asserted that their structure would probably be found 'to have resembled that of the still living phalangers, such as the Phascolarctos [koala] and Phalangista [possums and gliders], or the wombats'. He wrote in puzzlement to Owen's friend and collector, the physician George Bennett, in February 1870 of the strangely digitally-depleted Wellington Caves collections of the Australian Museum:

I quite understand Professor Owen's surprise regarding the absence of the Carpal & tarsal [finger and toe] bones of the gigantic Marsupials. I often wondered what had become of them. They are missing, that is a fact. I may be able to muster a second large [nail?] – but the one sketched is the only complete specimen in the whole collection. I cannot understand how it is that no large digits should occur as these bones are generally very common & always well preserved even those of the smallest Dasyures. But so it is; they are still missing. You may imagine that I looked for them so that I am as much disappointed as our learned friend.

Later that year Krefft made an intuitive leap based on the structure of wombat feet and the absence of 'large phalanges [finger] & metatarsal [toe] bones' from the Australian Museum collection. Writing to Owen in June 1870 with his usual mixture of self-confidence and obsequiousness, he enclosed 'one of the flat phalanges, which I suppose to be that of the thumb of a gigantic Phalanger, probably a Zygomaturus or Diprotodon' and 'the last nail-less digit, which may probably belong to it'.

Owen had also noticed the lack of giant digits corresponding with the fossils of the diprotodont marsupials. Krefft mused that as Owen was aware that 'the nail-bones whereof I sent you the photographs are much curved & compressed & different from Kangaroo nails', he may also have observed that 'the fossil metatarsals are short & thick & that it is therefore not impossible, considering that both Diprotodons & Nototheriums (or Zygomaturi) stood rather short on their legs & progressed like

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96 [Krefft] to [Robertson], 10 May 1869, Australian Museum Library collection.
97 [Krefft] to [Robertson], 10 May 1869, Australian Museum Library collection.
98 Krefft to George Bennett, 23 February 1870 [copy], Owen Papers, Krefft.
Wombats or Phalangers, that these animals had hind feet like Phalangers, four nailed toes & a nail-less thumb'.

Krefft observed that the presence of 'flattened digits of large size & short Wombat-like heel bones of large size' favoured this theory, along with the negative evidence of the absence of large metatarsals. He surmised that the flat digits were 'those of the thumb'. He congratulated Owen for his early classification of Diprotodon 'with the Wombats', a 'more correct position than the persons who would make a sort of Kangaroo of it'. Owen based his assumption on the comparison of teeth and jaws, as did Krefft in 1869, but by 1870 Krefft believed that the answer lay in the mysterious tarsal and carpal bones in the collection. Diprotodon, Nototherium and Zygomaturus 'had hind feet on the same principle as the Wombats or Phalangers; in this way only can we account for the absence of large metatarsals'.

Perhaps some of these bones corresponded with the 'Mylodon (?) Australis' toes and claws that he described to Owen in the letter of 13 July quoted above.

Krefft was a competent anatomist, but also rather paranoid, erratic and an alcoholic, controversially dismissed from the museum in 1874. He fell out with Owen in the early 1870s, engaging in a sustained attack on the British anatomist's identification of *Thylacoleo* as a lion-like marsupial carnivore. Krefft classed *Thylacoleo* with the phalangers and insisted that it was really no more than an overgrown possum, at best insectivorous, that might have used its blade-like incisor for stabbing melons and its 'formidable pre-molar' for 'bruising' its food.

In a scarcely hidden attack on Owen in 1873, he complained that 'owing to a scanty supply of the skeletons of modern marsupials' in England, and despite 'a good many years' of 'bones and teeth of mammals' being shipped 'Home in large quantities', distinguished naturalists had failed to be 'as correct' in their classifications 'as the owners of the fossils had a right to expect'. Their errors were 'indeed numerous and varied, the most harmless of creatures' being 'represented as "the fellest of the fell"'.

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100 Gerard Krefft, Correspondence, 1861-1878, Albert Gunther papers, unpublished TS, Australian Museum ref. AMS48, Sydney.

101 For example, see Krefft to W B Clarke, 19 May 1870, W B Clarke Papers, Mitchell Library, Sydney. See also W H Flower, 'On the affinities and probable habitats of the extinct Australian marsupial *Thylacoleo carnifex* Owen', *Quarterly Journal of the Geological Society* 24, 1868, 307-19, for his claim that *Thylacoleo* was herbivorous and subsisted on soft, ripe fruit.
Animals with 'all the true characters of phalangers' were 'persistently described as
allied to the kangaroos – the peculiar short tarsal bones of harmless kangaroos have
been explained to be those of great flesh-eaters'. These, and others, were explicit
criticisms of Owen's classifications, particularly his identification of Thylacoleo as a
large carnivore.\(^\text{102}\)

Owen was finally vindicated as to the carnivorous nature of the 'marsupial lion'
some ninety years after his death in 1892, Wells, Horton and Rogers asserting in 1982
that 'Thylacoleo carnifex was a flesh eating marsupial of diprotodontid ancestry
[which] killed its prey by holding it against the upper incisors and stabbing with the
livers, possibly leading to strangulation, suffocation or severance of the vertebral
column'. Their comparative anatomical and historical study led them to the
'speculative hypothesis' that Thylacoleo preyed on extinct browsing sthenurine
kangaroos, in association with whose remains they are often found. The authors
reasoned that it filled a leopard-like niche, dragging its prey into trees, removing it
from the reach of scavengers like Sarcophilus. Such an hypothesis 'is the simplest
which accords with all the available evidence'.\(^\text{103}\)

Chapter Nine has been about western European scientific understanding of the
fossil remains of former worlds during the nineteenth century, and how these
interpretations have reciprocally been affected by stories which emerge from
Australian landscapes. In particular I have focused on how Diprotodon remains were
understood and used by colonial and metropolitan naturalists, explorers and settlers.
These remains signalled and effected many changes in ideas about the age and
affiliations of Australia and its faunal productions. In a similar vein, Chapter Ten
begins with H Y L Brown's description of Aboriginal accounts of fossil bones as
belonging to mythical giant fish, never seen alive by his informants. The collection of
such stories was part of the Darwinian fact-gathering obsession of the colonial natural
historians of the late nineteenth century, men like A W Howitt and J W Gregory, who
feature largely in the section to follow. The tales are supposed to reveal something
about the tale-tellers as well as the landscapes, landforms and fossils which they
explain, but they also reveal much about the tale-gatherers. I have prefaced the chapter

\(^{102}\) All quotes from Krefft, 'Australian natural history', 135-6.
\(^{103}\) R T Wells, D R Horton and P Rogers, 'Thylacoleo carnifex Owen (THYLACOLEONIDAE):
Marsupial carnivore?', in Carnivorous Marsupials, ed. M Archer, Royal Zoological Society of New
South Wales, February 1982, 584.
with a quote from the modernist poet Wallace Stevens' mid-twentieth century poem, 'Thirteen ways of looking at a blackbird'. Like the chapter to follow, this piece is an exploration of ways of seeing and ways of looking. The 'circles' referred to can be understood as horizons, to which we need to re-orient ourselves as we approach each one and pass it. They also signify the unknowableness of familiar objects, which can so easily pass 'out of sight'.
Chapter X

Seven ways of looking at a fossil: Indigenous and imported explanations of bones in the landscape, 1845-1905

When the blackbird flew out of sight, It marked the edge Of one of many circles

The natives account for the presence of these bones by saying that they belong to the cadimurka, a large fish which lives in the bottom of the waterholes, and which has consequently never been seen by them

So wrote South Australia's Government Geologist Henry Yorke Lyell Brown in 1892. A native Nova Scotian, Brown trained at the Royal College of Mines. A student of A R C Selwyn in the first Victorian Geological Survey, Brown had recently examined country 'in the neighbourhood of Lake Eyre'. While in the region, he found the bones of extinct mammals, crocodilians, turtles and birds in the channels of the Cooper and Strzelecki Creeks, and recorded the above account of their origins (Plate 20).

Seven years later, on his return from a very productive collecting expedition to the Diamantina and Warburton rivers to the northeast of Lake Eyre (Plate 20), E C Stirling wrote to the South Australian Museum board that he had found fossils 'of an unusually interesting character and variety'. Given the region he explored, he might have found reptilian as well as mammal and bird fossils, Tertiary as well as Pleistocene. This suggests the non-specificity of cadimurka-kadimakara-type legends across different groups of Aboriginal people and different types of extinct fauna. In any case, according to Stirling's account, local people (possibly Ngamini of northeastern South Australia, and northern Dieri) attributed the bones 'to some mystical animal' which they called 'Cúdimûrkúra & which seems to play the rôle of a

4 Horton, Encyclopaedia, 350-1.
local bunyip'. In keeping with Brown's account of nearly a decade earlier, far from
dying when the land dried up like the related but far less durable kadimakara, they
were 'supposed to live at the bottoms of the deep water-holes'. Unlike Brown, who
labelled it a kind of fish, Stirling declared it 'impossible to gain any clear idea as to the
particular form assumed by it.'

Palaeontologists regard these bones as Pleistocene and late Tertiary, evidence
of a formerly watered inland when much of central Australia was covered by a
receding sea or a giant freshwater lake system. Aboriginal people have a number of
different versions of the origin of giant bones in the landscape. The later nineteenth
century saw considerable interest in unseen animals such as cadimurka, bunyips and
their mythopoeic megafaunal kin. These huge beasts from a lost world alternately
wreaked havoc like the giant kangaroo Kuperee, lurked at the bottom of waterholes
like the cadimurka and bunyip, or lived in the sky-land above the once fertile desert
like the kadimarkaras, but most importantly they left giant bones and stories scattered
across the land as an elaborate, mysterious legacy for ethnologist, folklorist and
geologist.

The 'indigenous and imported explanations' of the title of Chapter Ten describe
the intellectual impact of fossil bones and fossil landscapes on secular scientific and
traditional stories of landscape genesis. Of course these particular indigenous
explanations are mediated through imported scribes. Equally, in their efforts to
understand the origins of Aboriginal accounts of bones in landscapes, and to explain
that for which they had no precedent, those scribes were influenced by the
explanations offered by their Indigenous informants. Four of these seven ways of
looking at a fossil are transcriptions or renderings by naturalists and ethnographers of
Aboriginal 'folklore' relating to the presence of fossils in lake beds, caves or river
banks. The fifth involves Aboriginal input, in the person of Jackie Nolan, but it is
essentially an account of value-adding in a landscape by scientists and pastoralists.
The final two ways of looking involve English explorers and scientists in a 'fossil'

5 E C Stirling to the Museum Committee (South Australian Museum, Adelaide), 1 October 1899, Lake
Callabonna Papers, Department of Vertebrate Palaeontology, South Australian Museum (hereafter
Callabonna Papers, SAM), Adelaide.

6 For the story of Kuperee, which is not addressed here, see [W A Cawthorne], The Legend of Kuperree;
Or the Red Kangaroo. An Aboriginal Tradition of the Port Lincoln Tribe; A Metrical Version: By the
Author of The Islanders, 2nd edition (Adelaide: A N Cawthorne, nd [1858]), Mf C48, Sydney, Mitchell
Library; and Mary Grant Bruce, The Stone Axe of Burkamukk (London and Melbourne: Ward, Lock &
landscape. Their interpretations of such landforms as sand dunes or dry lakes as fossil or relict features provides a prosaic counterpoint to their dramatic imaginings of inland seas and lush, forested lake landscapes filled with browsing herds of Diprotodons.

**Koppa the spirit of the caves?**

European naturalists sought Aboriginal expertise at the first discovery of a former world of Australian giants. In contrast to the channels of the Darling Downs and the fluctuating lakes and swamps of western Victoria, the lush limestone soils of the Wellington Valley in New South Wales provided few surface fossils for the local people to weave into their stories of landscape genesis (Plate 20).

In 1828 or 1829 'that very respectable Colonist and Magistrate, George Ranken, Esq of Bathurst' discovered the rich lode of mysterious giant bones underground in the Wellington Caves. J D Lang, with avowedly 'little acquaintance with the science of comparative anatomy and none whatever with that of fossil osteology', but a passing familiarity with William Buckland's writings on the fossils of Yorkshire's Kirkdale Cave, stated that 'it is quite evident that the greater number of the bones in question are not those of animals of the species at present inhabiting this territory. In the absence of 'such men as Professor [Robert] Jameson [of Edinburgh], or Professor Buckland, or Baron Cuvier', Lang found other convincing anatomical testimony: 'The aborigines are very good authority on this point … for when shewn several of the bones, and asked if they belonged to any of the species at present inhabiting the territory, they uniformly replied, *Bail that belongit to Kangaroo, Bail that belongit to emu, &c. &c*.7

Lang deduced that people so competent as to the region's living osseous productions could hardly fail to identify the bones of living giants. They must therefore have belonged to extinct animals that the Aborigines never encountered. The only shadowy suggestion of indigenous familiarity with the Wellington Caves bones in Lang's account appeared parenthetically: 'the Aborigines have a superstitious repugnance to entering any cavern, saying, *Koppa*, the spirit of the caves in the Aboriginal mythology, *Koppa sit down there*.8

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7 Lang, 'An account of the discovery of bone caves', 366.
8 Lang, 'An account of the discovery of bone caves', 366.
The bunyips of Lake Colongulac

William Adeney, the owner of Chocolyn Station near Camperdown in Western Victoria chose to emphasise the supernatural elements of Aboriginal accounts of fossil bones. In 1845 or 'not long since' he found fossil bones 'belonging I think to some extinct and undescribed animal' at Lake Colongulac, called by the settlers Lake Timboon or Lloyd's Lake (Plate 20). These fossils evoked a reflection on monsters and the savage imagination from the young pastoralist.

Unlike Lang the cleric, Stirling the naturalist, and Brown the geologist, Adeney the farmer, in a letter to his mother, dismissed any possibility of Aboriginal familiarity with the living animal. However, like Harold Fletcher half a century later, he did acknowledge a link between the bones and their 'creature of the imagination'. They invented the latter to fit the former into a landscape system which, like the world of Browning's Fra Lippo Lippi, is 'no blot for us, Nor blank – it means intensely. 'To find its meaning' was their 'meat and drink'.9 The bones, as Adeney continued to his mother,

excited much interest here for some time as they were at first supposed to belong to a large animal described by the natives as the Bunyip and affirmed by them to be still alive in some of the deep lakes and waterholes of this district. I think this to be only a creature of their imagination and not being able to account for these remains they have placed them to the credit of that fearful monster which they describe as going on two legs with a neck and head like a large [emu] and a breast covered with shaggy hair and killing men by hugging them with his large flappers.10

They excited interest elsewhere as well. Adeney sent them 'to one of the Geelong scientific men here', probably E C Hobson, 'who proposed their being sent to [Richard] Owen in London'. He wrote to Owen, promising to send more bones as he found them, never imagining the century of speculation he had unleashed on the world of comparative anatomy, unready as it perhaps was for a giant carnivorous possum:

10 All quotations in this section by Adeney can be found in William Adeney (Chocolyn, Geelong, Port Phillip, New South Wales) to Mrs Adeney (England), 29 November 1845, Letter 10, in John Adeney, Letters, 26 January 1822-1860, MSB453, La Trobe Collection, State Library of Victoria, Melbourne.
On closely comparing this fossil with the skulls of existing carnivorous animals of the placental and marsupial orders, Professor Owen concluded from the structure of the occiput, of the organ of hearing, and of the bony palate, ... that the large carnivore represented by that fossil belonged to the marsupial order, not to the placental Carnivora. He had proposed for it the name Thylacoleo, or 'lion with a pouch'. Thus were completed by evidence of species of quadrupeds that appear to have become extinct in Australia, the representatives in the marsupial series of the chief forms of the terrestrial Mammalia known in other parts of the globe.11

Interestingly in the light of Adeney's description of the bunyip 'as going on two legs with a neck and head like a large [emu] and a breast covered with shaggy hair',12 the lake also relinquished the bones of Genyornis newtoni, a flightless bird not dissimilar to a gigantic goose or huge stocky emu, although from a different family.13 Owen could not identify these bones as anything more than avian from the limited fragments provided from Lake Colongulac, so Genyornis remained unnamed by white men until Stirling and Zietz described the first Callabonna fossils in 1896.14 But it seems the people of the lake had enough experience with bones to begin to reconstruct something resembling the burly biped. Reasoning inductively, they then located the animal in 'the deep lakes and waterholes' next to which they found the bones.

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11 Sydney Morning Herald, 1847?, Taylor, Norman, Personal file of newspaper cuttings and notes, 1854?-1894, MSB515, La Trobe Collection, State Library of Victoria, Melbourne.
12 William Adeney to Mrs Adeney, 29 November 1845, State Library of Victoria, Melbourne, MSB453.
14 E C Stirling and A H C Zietz, 'Preliminary notes on Genyornis newtoni, a new genus and species of fossil struthious bird found at Lake Callabonna', Transactions of the Royal Society of South Australia, 20(1) 1896, 171-90; idem, 'Description of the bones of the leg and foot of Genyornis newtoni, a fossil struthious bird from Lake Callabonna', Transactions of the Royal Society of South Australia, 20(2) 1896, 191-211; idem, 'The newly discovered extinct gigantic bird of South Australia', Ibis, 7(2) 1896, 430, 593.
The gyedarra of the Darling Downs

In December 1871 the naturalist George Bennett wrote a letter to his long time friend and collaborator Richard Owen, describing 'his excursions in quest of materials' for the work on which Owen was then engaged, 'descriptive of the fossil mammals of Australia'. Bennett recorded that on his return to Brisbane one of his former hosts, Mr G B King of Gowrie Station on the fossil-rich Darling Downs wrote to him regarding 'an important tradition respecting these extinct animals obtained from one of the aborigines'. Having found 'a few very valuable fossils' apparently of Diprotodon, Mr King had a long conversation with "Charlie Pierce," an aboriginal, relative to these fossils:

he avers that they are those of an animal long since extinct, known to the natives by the name of 'Gyedarra'. Tradition among them has handed down the appearance and habits of this animal for generations; but Charlie says he never paid much attention to the descriptions that have been given to him, but imagines the animal was as large as a heavy draught-horse, walked on four legs, the same as any other four-footed beast, eating grass, never went any distance back from the creeks to feed, and spent most of its time in the water, chiefly in enormous holes excavated in the banks. I told him he must mean some other animal; but he spoke most positively, and asserted that the bones we have been finding are those of the animal of which he was speaking, and that at one time the bones were very numerous about the Gowrie water-holes, where his forefathers had seen the animals themselves sporting about. I asked him again if they did not live on the leaves of trees; and his reply was that they were never seen to feed on them, but always on grass, the same as a horse or bullock.

In contrast to his fellow pastoralist Adeney, King chose to describe Pierce's

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16 Interestingly, A W Reed recorded the similar 'Jeedara' as a 'large, mythical watersnake' in his Aboriginal Words and Places of 1977 (Sydney: Rigby), 92.

17 Bennett, 'A trip to Queensland', 315.
account in an actualistic rather than folkloric fashion. Whether Charlie Pierce
described a living animal with which his ancestors were familiar or extrapolated from
the bones and what he knew of living placental megafauna such as horses and cattle,
his reasoning from analogy was not so far removed from the science of the
comparative anatomist, and more sophisticated than many of the Queensland
pastoralists to whom Bennett showed Owen's engravings. King found Pierce's matter-
of-fact description compellingly scientistic. On the other hand Bennett represented the
'power' of the palaeontologist to 'depict the ancient race' in mystical terms:
The 'old bones' (by many considered useless, and thrown away, or
which, as some informed me, were broken to discover if they were
really bones or stones assuming their forms) they never imagined
could be so treated by palaeontologists, who they were not aware
possessed the power, until they saw these works [of Owen's], of
depicting the ancient race of Australian animals, re-forming them
into living structures, imparting to these long extinct animals the
motion of antiquated life, and, as fossils bear the marks of their
relative antiquity, are enabled to fix the date of the rock in which
they are found.18

Kadimarkaras in the dead heart
Among other anthropological work at the Lutheran mission at Lake Killalpaninna,
Otto Siebert collaborated with the geologist and ethnologist A W Howitt in 1902.
They chronicled 'two legends of the Lake Eyre Tribes'19 – Dieri landscape histories
explaining the formation of particular features in the region. The first explanation
describes 'animals called "kadimarkaras" which are said to have descended from the
sky-land to the earth by means of the huge eucalyptus tree which then grew along the
shores of Lake Eyre supporting the sky'.

In line with Brown's and Stirling's inferences during the last decade of the

18 Bennett, 'A trip to Queensland', 321.
19 A W Howitt and Otto Siebert, 'Two Legends of the Lake Eyre Tribes', Report of the Ninth Meeting of
the Australasian Association for the Advancement of Science, Hobart, 1902, 525-32. Howitt also
recounted variations on the 'Kadimarkara' tradition, including the story of Ngura-wordu-punnuna, in
The Native Tribes of South-East Australia (London: Macmillan and Co., 1904), 432-3, 800-6. In this
version the bones were those of Mura-mura ancestral beings among which Ngura-wordu-punnuna
numbered until he turned into a Kadimarkara himself after swallowing one of the giant beasts whole.
previous century, Howitt and Siebert explained that the Dieri identified kadimarkaras as 'the fossilised extinct creatures which have been found in some places near Lake Eyre'. They speculated that 'the legend has either been built up to account for the existence of the fossils, or, presumably, may be a survival of a memory of a time when the blackfellows' ancestors hunted them when they still lived in the then marshy trails of the Lake Eyre deltas' (Plate 20).

In support, Howitt explained that the 'fossil remains of diprolodin [sic] birds and other extinct marsupials found at Lake Callabunna [sic] and other places in the deltas of the rivers flowing into Lake Eyre are considered by the aborigines to be the remains of the kadimarkara'. Some of the monsters were excreted at named localities by Nura-wordu-bununa (or Ngura-wordu-punnuna), the protagonist of the second story, after he turned into a giant snake whose coils formed the Cooper Creek. This suggests that the Dieri treated the bones as they would any other element of their imprinted landscape, like the meandering channel of a river, as part of a complex of beginnings, significations and mnemonic and heuristic tools. Howitt was particularly concerned with comparing such central Australian traditions to those of Victorian and east coast tribes. The comparative folklorist approach offered by Siebert's reports suited his purpose.

At roughly the same time as Howitt and Siebert published their two legends, J W Gregory, the Professor of Geology and Mineralogy at the University of Melbourne, recounted 'How the Kadimakara came down from the skies' in the opening chapter of his palaeontological adventure story, The Dead Heart of Australia. Gregory regarded the 'myths' of the Indigenous Australians as 'distorted history' and hence 'of the most importance to the geographer and the ethnologist', as they 'give valuable suggestions, as to the former conditions of Australia and the distribution of the Australian people'. His version of the kadimakara narrative, written for a general audience, is somewhat easier to interpret than the Howitt and Siebert transcription so I reproduce it here at some length:

According to the traditions of some Australian aborigines, the

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20 See also Howitt, Native Tribes, 805.
21 For some of his comparisons of Dieri with other tribes' knowledge traditions regarding giant animals see Howitt, Native Tribes, 432-3.
22 Gregory, The Dead Heart, 3-7.
23 Gregory, The Dead Heart, 223.
deserts of Central Australia were once fertile, well-watered plains. Instead of the present brazen sky, the heavens were covered by a vault of clouds, so dense that it appeared solid; where to-day the only vegetation is a thin scrub, there were once giant gum-trees, which formed pillars to support the sky; the air, now laden with blinding, salt-coated dust, was washed by soft, cooling rains, and the present deserts around Lake Eyre were one continuous garden.

The rich soil of the country, watered by abundant rain, supported a luxuriant vegetation, which spread from the lake-shores and the river-banks far out across the plains. The trunks of the lofty gum-trees rose through the dense undergrowth, and upheld a canopy of vegetation, that protected the country beneath from the direct rays of the sun. In this roof of vegetation dwelt the strange monsters known as the 'Kadimakara' or 'Kadimerkera'.

Now and again the scent of the succulent herbage rose to the roof-land, and tempted its inhabitants to climb down the gum-trees to the pastures below. Once, while many Kadimakara were revelling in the rich foods of the lower world, their retreat was cut off by the destruction of the three gum-trees, which were the pillars of the sky. They were thus obliged to roam on earth, and wallow in the marshes of Lake Eyre, till they died, and to this day their bones lie where they fell. After the destruction of the gum-trees, the small holes in the forest-roof increased in number and size, until they touched one another, and all the sky became one continuous hole; wherefore the sky is called 'Puri Wilpanina', which means the 'Great Hole'.

At times when the country is wasted by prolonged drought, or the floods from the Queensland hills lie too long upon the hunting-grounds, the aborigines make pilgrimage to the bones of the Kadimakara. There corroborees are held, at which blood sacrifices are offered and dances performed to appease the spirits of the dead Kadimakara, and persuade them to intercede with those who still
dwell in the sky, and control the clouds and rain.\textsuperscript{24}

Entranced by these hints of a lost world, Gregory hoped that together the earth sciences and the 'folk-lore' recorded by ethnologists could begin to uncover the secrets of the dead heart. He hoped to find a corrective for the desiccation of the Lake Eyre basin, whose profligate waters, 'drained off five hundred thousand square miles of country', are all absorbed, 'for the lake has no outlet, and none of the water it receives is passed on to areas, that would make better use of it'.\textsuperscript{25}

The region was not always thus. In time past, during the incalculable Pleistocene, its fresh waters 'became salt and the fish and crocodiles were all destroyed … the vegetation withered; the once green, succulent herbage was replaced by dry, spindly plants; the giant marsupials died of hunger and thirst; hot winds swept across the dusty plains, and the once fertile basin of Lake Eyre was blasted into desert'.\textsuperscript{26} That central Australia formerly was lush and productive magnified the tragedy of its present 'heart-breaking wilderness' and the traveller's 'appeal to the engineer to remedy its wrongs' should not be regarded as 'impudent interference with the intentions of the Almighty'.\textsuperscript{27}

Gregory closed his book with an essay on 'the proposal to flood Lake Eyre from the sea'.\textsuperscript{28} Only 'owing to the scanty supply of water' did the land lie 'withered and wasted'. As the lake is several feet below sea level, proposals to flood it permanently via a canal dug from Spencer Gulf or from the Gulf of Carpentaria have been several times revived since an early recommendation of 1883, not least during the 1982-3 drought and again in mid-2002 during the latest El Niño phase. In reaction to widespread proposals to divert the eastward-flowing rivers of Queensland and New South Wales to the drought-stricken west of those states, an editorial in the \textit{Canberra Times} in October 2002 pointed out that 'There's nothing like a drought to bring forward recycled, impractical, and environmentally insane ideas about diverting rivers and making the deserts bloom'. In times of 'normal' rainfall, 'such "visionary" ideas are

\begin{thebibliography}{9}
\bibitem{Gregory1977} Gregory, \textit{The Dead Heart}, 3-4.
\bibitem{Gregory1978} Gregory, \textit{The Dead Heart}, 147.
\bibitem{Gregory1979} Gregory, \textit{The Dead Heart}, 151.
\bibitem{Gregory1980} Gregory, \textit{The Dead Heart}, 343.
\bibitem{Gregory1981} Gregory, \textit{The Dead Heart}, 342-52.
\end{thebibliography}
treated, as they ought to be, as deliriums'.

In support of this claim, the *Advertiser* of 3 March 1983 wrote of then Queensland Premier, Sir Joh Bjelke-Petersen's proposal to divert Queensland's major rivers through the Great Dividing Range 'to try and spread the water around his State rather than let it go to waste', eventually to fill Lake Eyre and 'make the Outback blossom'. The 2002 article added caustically that 'when enthusiasts and cranks are adopted by crude populists like [radio shock jock] Alan Jones, the latest unthinking spruiker for turning the rivers back, it's time for responsible politicians to tell the world these panaceas are cruel hoaxes.' In 1983, critics dismissed 'the more-water, more-rain theory by citing the barren shores of the Red Sea and the dusty Nullarbor'. Similarly, Gregory decided in the end that the rewards would be few and the expense great, musing that the 'flooding of Lake Eyre might do as little good to Central Australia as the Dead Sea does to its barren basin'. Still, the 'myths' relating to the ubiquitous bones of extinct megafauna could help fill in the gaps in the story of inland aridity.

That the kadimakara stories were widespread among Lake Eyre tribes 'with variations in the form of the names, and in other details' suggested to the intellectually promiscuous geologist any of three possible origins. They 'may have arisen as a pure fiction' invented 'by some imaginative, story-telling native, to explain why large bones are scattered over the bed of Cooper's Creek'. On the other hand, they may 'be a shadowy reminiscence of the geographical conditions which existed in some distant ancestral home of the aborigines' or finally, 'of those which prevailed in Central Australia, at some remote period'. In deducing the truth or fancy behind the legends, the 'geologist may, therefore, hope to help the student of the Australian aborigines, by explaining some of their traditions, by throwing light on their migrations, and by

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30 Doug Peter, 'Turning the rivers: Plans to create an Outback oasis find favor after 50 years', *Advertiser* (Adelaide), 3 March 1983, 5.

31 For example, see Anon., 'Time to ditch cruel hoaxes', 12. See also F B Ragless, 'Found famous fossils', unprovenanced newspaper clipping [1938?], Margaret E Ragless collection: In about 1938? Frederick Ragless suggested that by diverting the 'North Queensland rivers, which now spill their floodwaters into the sea' by way of the Cooper and Strzelecki, 'Callabonna would possibly become a fresh lake' as he surmised it had been in the distant past.

32 Gregory, *The Dead Heart*, 352.

33 Gregory, *The Dead Heart*, 5.
showing the date of their arrival in Australia'.

Thus the intersection of Gregory's intellectual duty with the economic imperative to make the dead heart bloom again demanded he speculate on the origins of the Kadimakara myths. Drawing on his earlier field experience, he found parallels with East African traditions. He concluded therefore that central Australia may have been similarly verdant and humid within the span of human occupation, or alternatively the Aborigines had migrated from somewhere tropical and brought their stories with them: 'Those who interpret the Kadimakara legend by the light of a knowledge of tropical forests, naturally see in it either a reminiscence of the time, when the geographical conditions of Central Australia were different from those that prevail at present, or a reminiscence of the country whence the aborigines migrated to Australia'. Desert-dwellers would dismiss as 'the idlest fancy' a notion that 'the vault of heaven could be upheld by trees, or that the open, transparent sky could support heavy animals of flesh and bone'.

Howitt, himself a desert-dweller for periods of his expeditionary and ethnographic work, presented the counterfact to Gregory's thesis:

When one comes to consider it, one should not feel surprised that the Australian Savage thinks that the earth is a flat limited surface, and the sky a hard vault over it. I have been struck by this appearance myself when in the vast extents of the open treeless country in the interior of Australia … there are even now persons who, otherwise sane, believe the earth to be a flat plane. It seems that such pseudo-beliefs are an inheritance to us from our savage ancestors, and from which we are not able to free ourselves.

Gregory himself wrote of the desert at night in a later chapter of The Dead Heart that one of the main charms of the desert is the sky. Never does it look so solid, not feel so close. Nowhere else do we feel so sceptical of astronomical distances; for as the night wears on the sky seems to creep down closer, until it appears almost within touching distance,
and to have wrapt the earth in a celestial peace.37

On the other hand, to a man like Gregory, familiar with the tropical forest, 'it appears inevitable that the first attempts by primitive forest-people to explain the world around them, must closely follow the lines of the Kadimakara legend':38

If the pygmies in the East African forests have any theory of the limited universe known to them, they probably regard it as a two-storied structure, in which they occupy the lower floor … high above them is a thick, felted layer of foliage and creepers, upheld by the trunks of lofty junipers, which rise straight to a great height before they branch. The tangled layer of vegetation overhead deprives the natives of any knowledge of the world above their tree-tops. They are covered by a sheet as opaque and as continuous as a roof slightly out of repair. In that roof live monkeys and birds and beasts, that never descend to the ground below; while the animals that live and move and have their being in the undergrowth are equally cut off from the world above. The primitive hunter has some slight knowledge of the jungle-roof above him. He hears the harsh halloa of the colobus, the shrill cry of birds when they fall a prey to snakes or monkeys; his keen eye can detect the prized fur of the colobus, despite its close resemblance to the long, hanging masses of grey-beard lichen, that drape the black branches of the trees. But the dweller in the underlying jungle knows nothing of the region above the tree-tops … he may see the stars slowly crossing the holes in the roof; but he … probably thinks of them only as fire-flies … The roof above him is his highest heaven, which supplies the rain that drips heavily from the sodden foliage. The occasional fall of a dead bird or a monkey is to him as much a gift from the gods as were the sky-stones, that supplied the Siberians and Eskimo with iron. The change from the dark of night to the dull gloom, that pervades the lower forest at midday, is clearly due to some change in or above the roof. But the forest-dweller has no clue to the


38 Gregory, *The Dead Heart*, 5-7.
distance; so he flattens the whole universe above him into one solid floor, supported by the tree-trunks, just as the Greeks projected all the star-zones into one solid firmament.39

Reasoning by such analogy, Gregory believed that unravelling the anatomy of both the myths and the fossil animals provided a key to the palaeoecology of the Lake Eyre region and the origins of the Aborigines of central Australia:

If the legends attribute to the extinct animals characters which they possessed, but which the natives could not have inferred from the bones, then the legends are of local origin. They would prove that man inhabited Central Australia, at the same time as the mighty Diprotodon and the extinct, giant kangaroos. If, on the other hand, there is no such correspondence between the legends and the fossils, then we must regard the traditions as due to the habit of migratory peoples, of localising in new homes the incidents recorded in their folk-lore.40

Gregory decided that 'several definite and important myths' of the Lake Eyre basin peoples suggested on the whole, 'a northern and an Asiatic origin'. Any 'changes' in the stories asserting different origins, he attributed to 'the habit people have of carrying their legends with them, and ascribing them to some locality in their new home'.41

The Dieri accounts of the kadimakara, he diagnosed as 'partly local and partly foreign'. As evidence, he cited differences, generalities and imprecisions in the kadimakara legends, which 'obviously relate to, at least, two distinct animals' – possibly the cadimurka of H Y L Brown and E C Stirling on the one hand and the kadimarkara of Howitt and Siebert on the other. The former 'lives in pools and attacks people who go near them. The commotion of a whirlwind, sweeping across a sheet of water, is explained as due to the presence of a Kadimakara swimming beneath the surface'. These monsters may be 'based upon the crocodile; for that the crocodile once swarmed in the rivers of Lake Eyre is shown by the abundance of their fossil remains'. However, the stories may equally 'have been invented' in Queensland, where

39 Gregory, The Dead Heart, 3-10.
40 Gregory, The Dead Heart, 7.
41 Gregory, The Dead Heart, 228-30.
crocodiles still live, and carried south.

The latter type of kadimakara ‘was a big, heavy land animal, with a single horn on its forehead’, suggestive of the Diprotodon, ‘but, in life, this projection probably supported a fleshy trunk like that of a tapir, and not a horn. So that the imaginary horn of the Kadimakara is most likely an imported idea’, a race memory of the rhinoceros for instance (note the interesting resonance here with earlier European naturalists, who imputed the bones of the giant marsupials to placental pachyderms like rhinoceros and hippopotamus).

The resemblance of ’some of the animal stories and the star legends of the Central Australian tribes’ to ’those of some African races' suggested their 'extraneous origin' most powerfully to Gregory, who was reminded more 'of the legends of the South African bushmen, than of those of any other race'. The central Australians 'most probably' lived formerly 'in a tropical forest-land' and adapted the stories of their old land to their new home, the same impulse which 'has induced the modern Australian, in spite of the confusion of geographical nomenclature, to give his newly raised southern towns such names as Croydon, Hamilton, Maryborough, or Heidelberg, to keep fresh the cherished memories of his fatherland'. Following Gregory's reasoning, the convenient coincidence of the fossil bone accumulations merely supplied the storytellers with a material confirmation of the myths, rather than providing their source.

To what extent does Gregory's account reflect the operation of some kind of anthropological or folkloric genealogy? He initially provided no source for the story other than 'the traditions of some Australian aborigines', forcing his readers to rely on the esteemed geologist-adventurer's implicit expertise. Its place at the beginning of the narrative has as much to do with the opportunity for whimsy and its resonance with the book's title as its relevance to the rest of his account. Howitt clearly influenced Gregory, who thanked the ethnologist on page 8 of *The Dead Heart*. Later in the book, Gregory attributed the story to Howitt, who, in answer to the geologist's enquiry 'whether the natives of Lake Eyre had any stories about the former size of the lake' told him the Kadimakara legend 'which was the direct cause of our journey'. Gregory may also have drawn inspiration independently from Siebert and Reuther while staying at

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42 Gregory, *The Dead Heart*, 230-5.
the Bethesda Mission at Killalpaninna in late December 1901. He noted that as 'a general rule, where stories of giants and dragons are assigned to precise localities, they are founded on the occurrence of fossil bones', giving as instances 'the legends of terrible monsters on the Island of Samos' which led 'to the discovery of the rich deposits of mammal bones, for which the island is now chiefly famous'. He also alluded to the 'legend of Sinbad the Sailor's roc' which was 'no doubt founded on the gigantic eggs of the extinct aepyornis, which are found in Madagascar'. He felt assured 'that, if only we could reach the places where the aborigines held corroborees to the spirits of the Kadimakara, we should find a rich deposit of extinct animal remains.'

Nearly a century after Siebert and Howitt published the Dieri explanation of fossil bones, Harold Fletcher recorded the response of 'Andy, one of the very few, if not the last, of the Dieri Tribe, who inhabited desert country east of Lake Eyre' and an 'assistant camelman' on C T Madigan's Simpson Desert expedition of 1939, to a very leading question:

On one occasion, I asked him if he knew of any large animal bones which became exposed after heavy rain or floods, or were in dried up river beds or lakes. He said they are well known to him and called Kadimakara. A legend of the tribe explained their origin. Long years ago the desert was covered with giant trees, the top foliage forming a canopy on which the Kadimakara lived. The ground, shaded from the sun's great heat, became covered with a growth of succulent vegetation that excited the appetites of the large animals. Finally tempted they climbed down the tree trunks and enjoyed the luscious food. As the years passed the beneficial rain declined, and practically ceased altogether. The giant trees perished and the lofty home of the Kadimakara no longer existed. The country, now exposed to the sun's heat and experiencing only

44 Gregory, The Dead Heart, 59-76.
occasional rainfall, quickly dried up. Vegetation gradually died off
and the lakes, claypans and rivers, once filled with water, became
muddy swamps covered with a treacherous saline crust.  

This version bears a striking resemblance to Gregory's account and in the light
of Fletcher's earlier patronising characterisation of 'Andy' as affably foolish with only
a limited command of English, suggests that perhaps Fletcher's familiarity with
Gregory's text informed his own:

I did my best to explain to [Andy] that I wanted to catch desert
mice, rats, lizards and snakes for the Museum in Sydney and would
like him to help me. I said he knew the habits and underground
nesting burrows of many of these creatures and would be of great
assistance. He replied, 'Me help, my name Andy me Andy name to
you'. At the time I wondered if he knew what it was all about, an
assumption which later proved correct. Always cheerful, Andy had
a terrific sense of humour, which sent him into paroxysms of
laughter at the slightest provocation and usually when chasing some
of the desert life. He was a hindrance rather than a help, but with
the very best of intentions always rallied round to help – also to
have a good laugh. As I left him he said, 'Me help my name Andy
me Andy man to you'.  

It is also probable that 'Andy's' command of English was better than Fletcher's
command of Dieri: no linguistic slouch, he 'could speak German as well as English'.
Educated at Killalpaninna, possibly by Siebert, perhaps 'Andy' was only prepared to
feed Fletcher the standard line in Kadimakara legends recommended for prying
ethnological ears, or perhaps Fletcher filled in the gaps himself as he wrote his account
in 1996 nearly sixty years after he met 'Andy'.

Mudrooroo recorded in 1994 that the Adnyamathanha elders tell of a giant
mammal-like animal 'either like a giant kangaroo or wombat which once roamed the
country', called yamuti. He suggested that this may correspond with the giant extinct

46 Fletcher, 'Delving into the past', 154.
47 Fletcher, 'Delving into the past', 90-1.
48 Fletcher, 'Delving into the past', 89.
marsupials whose bones weather out of Adnyamathanha country, in the Flinders Ranges and the western side of Lake Callabonna (Plates 20 and 22).  

'him elephant too much big'

Conversation with an intelligent blackboy led to their discovery. We were camped out, and I was telling him stories at night, how they made elephants carry wood and how these animals dropped it when a bell rang. That amused him, and after a while he said, 'I bin tinkit elephant alonga dis country one time'. I told him that elephants were too big to live in that country.

He was quiet again, and said, 'Me showem you big pfella bone alonga lake. 'Im too much big alonga bullock; 'im too much big alonga panto (horse)'. I asked him to take me out, and show me.

When we got back to the head station, we harnessed a couple of horses, and rode out into the lake on a Sunday. Sure enough, he showed me the skeleton of the Diprotodon, lying in six inches of water. The bones crumbled when I touched them. I picked out specimens to send to the Adelaide Museum.

Who was 'Jackie Nolan'? He could have been the hero of the story, bringing the light of science to a 'wilderness of fossils'. Or perhaps an accidental villain, inadvertently exposing the bones of a people's moral universe to rapacious miners. 'Jackie Nolan' is the name that Fred Ragless gave to the Aboriginal stockman at Callabonna Station who began the process which alerted the South Australian Museum to the presence of the Lake Mulligan bone collection. Ragless' condescending words indicate a thoughtful man, a traveller, well-versed in the landscape in which he worked, but perhaps uninitiated into or unfamiliar with local tradition.

From Fred's much later account of Jackie's description of the bones in the lake, it seems that they were a familiar part of the stockman's landscape that did not

50 Anon., 'Found the Diprotodon' ['Advertiser? (Adelaide)], unprovenanced newspaper clipping, 1938, Margaret E Ragless collection.
51 Anon., 'Fossils from a wilderness and a wilderness of fossils', *South Australian Register*, 22 March 1894, 6.
previously warrant comment although he had thought about them and recognised their singularity. Fred's report of sitting by a campfire impressing the workers with talk of elephants has a comfortable ring to it, an old story told and perfected over many years. Nonetheless, it is noteworthy that when recounting Jackie's contribution he made no mention of native 'superstitions'. Nor did he draw analogies with stories of bunyips, kadimakara or yamuti, with which he may have been quite unfamiliar in 1892. He simply, if somewhat paternalistically, described Jackie Nolan's quiet insistence that he had seen bones as large as elephants weathering from the lake and its corollary, that there must once have been elephants in the desert.

Fred recorded his own response as 'No Jackie … him elephant too much big peller [sic], him can't get plenty tucker longa this country', but was intrigued enough to accompany the stockman to the site some days later, on 12 June 1892, perhaps aware of a rumoured £1000 prize offered to the first (white) person to bring a complete Diprotodon skeleton to Adelaide. It seems Jackie Nolan made no mention of kadimakara either, observing only that the bones were bigger than those of a bullock or horse and belonged to an animal unseen by Aboriginal people. Fred observed that he 'was a real decent little chap and kept himself and his clothing scrupulously clean, nothing pleased him better than to tell him of other countries, and the different animals that lived in them'. He does not receive further mention in the memoir.

Other Aboriginal people frequented the lake bed and knew about the giant bones in the landscape, as the widespread kadimakara and yamuti traditions attest. Pastoralists and collectors knew who to ask for information about the locality of 'bone beds'. The South Australian Museum collector Henry Hurst wrote to E C Stirling in March 1893 from Lake Mulligan, that 'Seargeant Coppie sent me his blackfellow to point out another locality where large numbers of fossils of a different kind are to be had – I shall go there in a few days – We have not had much time to explore although we have heard of good fossils in other parts of the Lake'.

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52 Hans Mincham spoke to Frederick Ragless, then blind, in May 1950 at his home in North Adelaide (He died in the winter of 1953, aged 94). He told Mincham a similar story of the elephant and the unnamed Aboriginal person who showed him the fossils. (Hans Mincham, pers. comm., 2 February 2000, Adelaide).
53 Ragless, 'Seventy years ago', 83-5.
54 Ragless, Dust Storms in China Tea Cups, 92.
55 Ragless, 'Seventy years ago', 83.
56 Henry Hurst to E C Stirling, 16 March 1893, Callabonna Papers, SAM, Adelaide.
Given the apparent ubiquity of bones, both at Mulligan-Callabonna and in other claypans, dry lakes and river channels throughout the Lake Eyre, Cooper Creek and Flinders Ranges regions, how did the inland explorers remain oblivious to them over two decades of searching for an inland sea? Sturt particularly travelled during a drought when bones should have been weathering out of the sand and in his endless quests for water concentrated on creek beds where the Quaternary fossils most often appear. He skirted the Tirari desert in 1845, focus of Ruben Stirton's successful twentieth-century megafaunal forays. H Y L Brown, E C Stirling, J W Gregory and the Stirton expeditions all found Pleistocene remains when they looked – turtles, crocodilians and birds as well as mammals. Siebert was aware of the bones in the 1890s. Queensland's Condamine River region was by 1850 a renowned site for fossil mammals and reptiles. Ludwig Leichhardt, before setting out on his doomed expedition to cross the continent from east to west just two years after Sturt's return to Adelaide, expressed the hope that he would find Diprotodon and other megafauna, living or fossil, in the course of his peregrinations.57 Both he and the Polish explorer Strzelecki sent megafaunal bones to Richard Owen.58 Sturt himself, who had much to say about invertebrate fossils, used Thomas Mitchell's and others' accounts of the Wellington Caves megafauna in the published journal of his Murray-Darling basin expeditions in 1833 to support his hypothesis that the whole of western New South Wales had recently emerged from floodwaters.59

Indeed, Sturt looked for evidence of a lost world throughout his 1844-6 expedition, on the assumption that inland Australia was once, if not still, occupied by a vast inland sea. He observed in some detail the contents of empty Aboriginal villages at the edges of the Stony Desert and along the Cooper.60 But he did not find megafaunal remains.61 Science, other than geography, was a luxury, and even

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58 For example, Owen, 'Description of a fossil molar tooth of a Mastodon', 268-71; Owen, 'Report on the extinct mammals of Australia', 223-40. See also Strzelecki, Physical Description of New South Wales and Van Diemen's Land, 312. Strzelecki included a long extract from Owen's Descriptive and Illustrated Catalogue of 1845 (299-312).
59 Sturt, Two Expeditions, vol 2, 224-8.
60 Sturt, Journal of the Central Australian Expedition, 70; idem, Narrative of an Expedition, vol 1, 387.
61 Although see Ernestine Hill's unreferenced claim (not to mention anachronistic – Richard Owen did not name *nototherium* until the mid-1840s and the 'kadimakara' did not enter European ethnological consciousness until the 1890s) that Sturt collected megafaunal remains on the Central Australian
geography took a back seat to survival. Sturt observed the signs of Aboriginal habitation as a pointer to the condition of the country and the direction of water and feed for his horses. Ethnology for its own sake was also a secondary consideration. Locked up 'as fast as if [they] had wintered at the Poles' by a 'wild and difficult' country, the inland explorers lacked the means and the intellectual space to deal with Pleistocene bones, afraid that their own might bleach in the desert.\(^\text{62}\)

By the 1880s it was a different matter. The interior remained treacherous, but camels, the railway, the telegraph, artesian bores and denser European settlement facilitated travel, which in turn left more leisure for science. Evidence of Diprotodon and other extinct megafauna created a precedent for 'improvement': if the Far North of South Australia had once been humid enough to support such giants perhaps it could bloom again. Megafaunal remains, particularly Diprotodon, also provided a handy supplement to diminishing farm returns.

'land waves … and of a fiery red'

What do the stories European Australians tell about bones and landscapes suggest about their origins? Bernard Smith wrote that 'European control of the world required a landscape practice that could first survey and describe, then evoke in settlers an emotional engagement with the land that they had alienated'.\(^\text{63}\) One way for colonial governments to awaken such an engagement was to publish expeditionary journals. Knowing about the land fostered engagement with it.

Charles Sturt wrote in 1849 that the 'the principal object of the [1844-6] Expedition into Central Australia was to ascertain the past and present structure of the continent'\(^\text{64}\) – in other words, to discover and unravel the lost contemporary and former geographies of its interior. That pressing combination of scientific and economic imperatives fuelled by curiosity and wishful thinking encouraged European expansion into the centre in search of glory, gold and grain, fed European engagement with the

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\(^\text{64}\) Charles Sturt, 'An account of the sea coast and interior of South Australia with observations on
land, with Aboriginal Australians and with their 'folk-lore' (as with J W Gregory's palaeoclimatic speculations deriving from kadimakara), and continues to inform scientific and agricultural endeavour in the arid zone.

Even without the heuristic benefit of ancient bones, Sturt's geological observations of the centre of South Australia, buttressed with the authority of 'every explorer', suggested to him former inundation and a changed climate through time:

the continent of Australia was at one time more humid than it is now … the marks of floods, and the violence of torrents (none of which have been witnessed), are mentioned by every explorer as traceable over every part of the continent; but no instance of any general inundation is on record: on the contrary the seasons appear to be getting drier and drier every year.65

In Sturt's view any who followed him must admit the 'evidences of a past violent commotion of waters'. This evidence was written in the very ground. The 'immense tract of sandy desert' he crossed could only have been a sea-bed:66

That the range of hills I have called 'Stanley's Barrier Range', and that all the mountain chains to the eastward and westward of it, were once so many islands I have not the slightest doubt, and that during the primeval period, a sea covered the deserts over which I wandered.67

Keeping up the maritime theme, he noted of the Stony Desert in his journal on 20 October 1845 that

there is not a parallel to it on the earth's Surface. Other deserts there are but they present not the steel shod surface of this desperate region … I had hoped when I ascended the ridges and saw large plains before me that I had passed the Stony Desert but here it again spread before me on almost every side Shewing that I had crossed an Island, and from our Camp that dark sea bounds the horizon on


65 Sturt, *Narrative of an Expedition*, vol 2, 124.

66 Sturt, *Narrative of an Expedition*, vol 2, 130.

almost every side of us.68

The next day he noted that the surface 'presented the appearance of a heavily surf washed beach' and viewed 'the fiery top of a red sand hill that rose like an Island in that dark Sea'. On 25 October 1845, thwarted by the Stony Desert, forced by scurvy, drought and lack of feed for his horses to turn back from his final rush to the centre of the continent, he marvelled at the power of water in shaping this waterless land:

I slowly and sullenly led my horse down the hill, and when at the bottom could not but contemplate with amazement the force of the element that must have produced the effects around me. There was a plain as extensive as the sea covered over with the shivered fragments of former mountains. There were hills over which the floods must have swept clad … with the same imperishable materials.69

Sturt was a talented amateur naturalist working within a biblical scientific framework. His 1828-30 expeditions to western New South Wales and to the mouth of the Murray River convinced him that the interior of Australia emerged recently from beneath floodwaters or sea. He was pre-conditioned to interpret the central Australian evidence the same way. Sturt insisted that the sand ridges he saw in the interior of South Australia could only be caused by water:

they followed each other like the waves of the sea in endless succession, suddenly terminating … on the vast plain into which they ran. What … was I to conclude from these facts? – that the winds had formed these remarkable accumulations of sand, as straight as an arrow lying on the ground without a break … No! winds may indeed have assisted in shaping their outlines, but … [they] exhibit a regularity that water alone could have given. It struck me then … that the whole of the low interior I had traversed was formerly a sea-bed.70

Indeed, so convinced was he of their marine origin that he drolly labelled the

70 Sturt, *Narrative of an Expedition*, vol 1, 380-1.
dunefields 'land waves' in his account for Charlotte on first encountering them in August. His eyes told him it was a sea and even his own nomenclature reinforced the certainty:

From what I saw of the neighbourhood of Lake Torrens, I fear that we may descend into a region where there will be a succession of shallow basins of dry lakes. That the whole of this region has been covered by the sea is evidenced by many things. By its exceedingly low level, the level of the ocean, by the want of timber, by the salsolaceous character of its productions, and by the deposits of sands upon its surface, that are in truth so many land waves over an earth sea, so that if we fall to a lower level we may naturally expect a change for the worse.71

The Adnyamathanha have a different account of dune formation, more in keeping with modern palaeoclimatic inferences. They say that a huge whirlwind Madkandyi began in Western Australia and blew fiercely towards the east. It hit the Flinders Ranges and 'pivoted around them in a clockwise direction and when it got to the other side it stopped, which is why all the sand dunes are seen in ridges pointing towards the range.72

The surveyor A C Gregory's actualistic approach also resulted in a windier genesis for the dunefields than did Sturt's speculations:

The direction of the parallel ridges of drift sand appear to be the result of the prevailing winds, and not the action of water, it being sufficient to visit them on a windy day to be convinced that it is unnecessary to seek for a more remote and obscure cause than that which is in present operation.73

As Sturt himself did, Gregory sought an inland sea in the past rather than the present configuration of Australia. In 12 January 1895 at the Australasian Association for the Advancement of Science meeting held in Brisbane, he explained in his presidential address the contemporary conventional geological wisdom regarding what Sturt called

72 Mudrooroo, *Aboriginal Mythology*, 100.
73 A C Gregory, 'Expedition in search of Dr Leichhardt', 209.
the 'past structure of the continent’ that his years of observations had helped to unravel:

Australia, after its first appearance in the form of a group of small islands on the east, and a larger island on the west, was raised at the close of the Palaeozoic period into a continent of at least double its present area, including Papua, and with a mountain range of great altitude. In the Mesozoic times, after a grand growth of vegetation which formed its coal beds, it was destined to be almost entirely submerged in the Cretaceous sea [reduced to the area of a large island on the east coast and some small islands on the south-west and north-west of the present continent], but was again resuscitated in the Tertiary period with the geological form it now presents … [Its] climate … maintained a magnificent system of rivers which drained the interior into Spencer's Gulf, but the gradual decrease in rainfall has dried up these watercourses, and their channels have been nearly obliterated, and the country changed from one of great fertility to a comparatively desert interior, which can only be partially reclaimed by the deep boring of artesian wells.

Based on such maritime obsessions his namesake, the tireless J W Gregory, might have concluded that the inland explorers came from a well-watered place, or came to the new place across a vast sea: the stories of an inland or former sea were widespread among the tribes of nineteenth-century explorers, surveyors and pastoralists who searched for a route to the interior 'with variations in the form of the names, and in other details'. Like the kadimakara legends, this would presumably have suggested any of three possible origins to Gregory. They 'may have arisen as a pure fiction' invented by some imaginative, story-telling surveyor to explain the 'wave-like' shape of dunefields or 'land waves' and the vast sandy plains beyond the horseshoe lake. On the other hand, they may 'be a shadowy reminiscence of the geographical conditions which existed in some distant ancestral home' of the explorers or of those

74 Sturt, Narrative of an Expedition, vol 2, 187.
75 A C Gregory, 'Presidential address: The geographical history of the Australian continent during its successive phases of geological development', Report of the Sixth Meeting of the Australasian Association for the Advancement of Science, Brisbane, 1895, 10, 12. See also Cumpston, Augustus Gregory, 99.
conditions prevailing in central Australia 'at some remote period'.

Gregory could rule out the latter possibility as the source of the myths, whatever its real relation to the former state of the country: the arrival of the explorers in central Australia was fairly well documented. So they migrated from somewhere wet or insular or came across an ocean (perhaps of 'water dunes') and brought their stories of inundation with them: 'Those who interpret the [inland sea] legend by the light of a knowledge of [islands and oceans], naturally see in it … a reminiscence of the country whence the [explorers] migrated to Australia'. Desert-dwellers would dismiss as 'the idliest fancy' a notion that 'the whole of the low interior [they] traversed was formerly a sea-bed'. Gregory himself might have felt bound to muse that 'the first attempts' by primitive island or ocean-faring people 'to explain the world around them, must closely follow the lines' of the mystery of the horseshoe lake and inland sea.

So the land plays a part in the nature of our relations with it – both the land we came from and the land we came to. The serendipity of culture, climate, taphonomy and observation helped shape the chimerical intellectual landscape of 'the interior' every bit as much as fashion, preconception and economic necessity.

**A Diprotodon Golgotha**

Thirty five years after A C Gregory invoked a windy rather than a wavy mechanism to account for the shape of the inland dunefields, Ralph Tate 'referred to the Diprotodon Golgotha at Lake Mulligan, and furnished some notes' published in the *Advertiser* in 1893. He made no mention of parallel sand ridges to the north and east, but 'endeavouring to find out the conditions under which' the clay enclosing the skeletons had been deposited, he used his knowledge of sedimentology, botany and invertebrate palaeontology to provide the beginnings of a palaeoenvironmental reconstruction of the site that required a past freshwater regime.

The carcasses were buried in a blue sandy clay. Surveys indicated the low position occupied by Lake Mulligan 'in the depression in that part of Australia'. At 'a late period' it was inundated by waters of the Cooper. Tate found two species of freshwater plants, which in connection with the discovery of 'two valves of a

76 J W Gregory, *The Dead Heart*, 5.

77 Gregory, *The Dead Heart*, 7.

78 Sturt, *Narrative of an Expedition*, vol 1, 380-1.

freshwater shell found on the Cooper; also fragments of a univalve shell unknown' suggested a brackish or freshwater depositional environment. Tate also discovered (in a handful of sand provided by Stirling), described and 'named Blanfordia Sterlingii, after Dr Stirling', a freshwater shell that 'so far as was known … belonged to brackish water fringing the margin of the southern coast'. 'Little cylindrical tubes like caddis worm-cases' washed out of the sediment. Tate believed them to be 'casts of the rootlets of some plant'.

He theorised from the brackish or freshwater plants and fauna which Stirling exhumed that 'in some far back period' the interior of South Australia including Lake Mulligan-Callabonna had been 'a vast lacustrine region'. The Diprotodon 'and his kind were attracted to this green spot and died from want of food'. The extent of the 'graveyard', which could be traced 'in a lineal direction from seven to eleven miles', supported this theory. The behaviour of stock and emus suggested modern analogy:

A case had been mentioned of the utter destruction of a mob of emus that were in the habit of periodically visiting a tract of country near Eucla, and all died of starvation owing to their one season remaining too late and being compelled to perish in the desert. Somewhat similar conditions might have brought about the wholesale destruction of the Diprotodons.

In addition to filling out the details of a piece of South Australia's deep past, the Mulligan-Callabonna site provided 'bones which helped to fill up the anatomy of the Diprotodon, which would give a clue to its habits'. Finally questions could be answered regarding the structure of Diprotodon feet, partly vindicating Krefft's speculations a quarter of a century earlier when he mused on the existence of southern sloths and the absence of giant toes in the Australian Museum collection. It seemed to Tate 'more like a megatherium' than either a kangaroo or a wombat, with large feet 'but the fingers too small for a burrowing animal; the hind legs were longer than the fore-legs. There was no doubt that it was a marsupial'.

The mysterious foot-bones from the Wellington Caves could now be linked conclusively to the Diprotodon and its nearest extinct relatives, although Krefft was not credited with their recognition.

Similarly, neither Tate nor Stirling acknowledged the museum collector Henry

80 Anon., 'Royal Society of South Australia', Advertiser, 6 September 1893.
Hurst's initial tentative identification of the giant marsupial's sloth-like nature on first viewing its feet at the 1893 site. Tate may have been unaware of the collector's opinion, which Hurst outlined in a letter to Stirling six months earlier:

What a volume of doubt will be removed when the remains are investigated in Adelaide – … I am fully inclined to believe that the Diprotodon was a sloth-like animal which used its powerful fore-arms for grasping and tearing down trees – The feet I possess show that the animal had 5 well-developed toes.81

By 1893 Tate was still unwilling completely to abandon the possibility of Pleistocene glaciation of southern Australia as a mechanism to explain megafaunal extinction. But even without his icy hypothesis, the evidence for sweeping climate change was compelling. Geomorphological evidence pointed to 'great change … over the surface' of the colony. Dry lakes and creeks indicated altered fluvial regimes with less precipitation and higher evaporation rates. Elevated coastlines indicated wholesale changes to the shape of the country.82 As discussed in Chapter Four, Part Two, climate change suggested one possible mechanism for the extinction of megafauna, not just to Ralph Tate but to his esteemed European colleagues. His understanding of natural science, his reading of landscapes and their productions, told him something significant had happened in the relatively recent past, although the details eluded him as they continue to elude earth scientists after the turn of the twentieth century. Like J W Gregory, he recognised the 'intimate connection' of 'the geological history of [Australia's] past and present configuration' with the origin and distribution of life.83

81 Henry Hurst (Callabonna Station) to E C Stirling (Adelaide) 11 March 1893, Callabonna Papers, SAM.

82 For example, Tate, 'Anniversary address of the President for 1878-9', lxiv; idem, 'Glacial phenomena in South Australia', 231-232; idem, 'Century of geological progress', 43; idem, 'Anniversary address of the President for 1894-95', 276.

83 Tate, 'Century of geological progress', 40.
Chapter XI

Finding Lake Callabonna, 1892-1901

This chapter begins with the elaboration and reinterpretation of old stories about the intersection of the history of vertebrate palaeontology with Lake Callabonna. These intersections emphasise the importance of fossil remains as an intellectual and material resource in nineteenth century Australia. The invention of Lake Callabonna as a significant South Australian landscape – the past as a resource – is central to the final two sections of Chapter Eleven: 'The recuperative power of the deep past' discusses the sacralisation of landscape enabled by the appreciation of the material remains of the past; and 'South Australian proto-nationalism, intellectual capital and the mobilisation of the deep past' is an exploration of the nexus of antiquity and nationalism.

The bone thieves

Meldrum's bones make history

It was in this environment then, of overwhelming scientific and public curiosity about the material remains of South Australia's past, that John Meldrum gathered a bundle of Lake Mulligan bones in October 1892, and rode as hard as he could for Adelaide, and into notoriety. Simultaneously robbing Lake Mulligan of its hard-won individuality and 'Jackie Nolan' of the sharp eye and enquiring mind that might have encouraged him to show the bones to an interested white man, the South Australian Register reported on 4 November that Meldrum, a 'well-sinker … from Ragless's Calaburna Station, on the eastern side of Lake Frome' arrived in Adelaide the previous Tuesday evening, bringing with him

some interesting fossiliferous specimens of the gigantic mammal Diprotodon [sic] Australis … found on the shores of the lake, about four miles from the head station. Mr Meldrum … was prospecting for water on the sandy shores of the lake, and at a spot where freshwater springs were known to exist. The surface sand had been blown away, revealing the bones referred to and others of larger size, which were difficult to transport on horseback.

The Register trumpeted that the primary interest of these bones, which suffered
'in the manner of transport and exposure to the air' on the long trek to Adelaide, lay in 'the proof of the existence of the giant, extinct marsupial of centuries ago in a locality in which its fossil remains have not hitherto been discovered', despite the criss-crossed tracks of fifty years of exploration, surveying and pastoralism in and around the locality. Once again, millennia of human husbandry were written away in a few words.

Having searched the lake all day, apparently Meldrum did not look far once he found the fossil site, simply grabbed as many fossils as he could easily carry. But he did notice bones 'of three carcasses' exposed on the surface near the specimens he collected, with 'joints of some of the femoral or thigh bones … as large as an ordinary-sized basin'. Alert to the promise of fossil wealth, the Observer ran the article as well. Such was the excitement that the anonymous scribe urged that 'Dr Stirling and Mr Zietz be laid on their track, as this interesting discovery is coequal with that recently made by our Government Geologist on his recent trip to the North'. On this trip, H Y L Brown also found Pleistocene fossil remains in the sediments of the Cooper and Diamantina in 1892. Indeed, the necropolis quickly eclipsed the Cooper Creek assemblages: the Register reported that 'Mr Brown says that this is certainly the most remarkable discovery of fossil remains ever made in Australia, and perhaps the most singular ever made anywhere'.

Notwithstanding its 'singularity', seven months later the newspaper still reported the locality as 'near Lake Frome'. The Adelaide press compared the discovery of the Lake Mulligan remains to the Wellington Caves discoveries of 1829-31 for international scientific significance, and again the Register confused the location of the latter (well south of the Liverpool Plains), the timing of Mitchell's expedition (1830 – ten years later than the newspaper claimed), and wrote George Ranken out of the story, insisting that

Since Major (afterwards Sir Thomas) Mitchell, the explorer, found fossiliferous remains in the Wellington Caves, Liverpool Plains, New South Wales, some seventy years ago, to no other similar discovery has been attached more interest by the scientific world than to that of the giants now being exhumed by our Museum

1 Anon., 'Mammoth fossils from the Interior', South Australian Register, 4 November 1892, 5; Adelaide Observer, 5 November 1892, 31.
2 Anon., 'Remarkable discovery of Fossils', South Australian Register, 13 June 1893, 5; Adelaide Observer, 17 June 1893, 15.
authorities on the shores of Mulligan Lake in this colony.  

The museum sent collectors to the site for reconnaissance. The board appointed Henry Hurst, formerly of the Queensland Geological Survey, who had also collected for the Queensland Museum, to lead the first expedition team. John Meldrum found employment there too. Meldrum wrote later that when he first arrived in Adelaide in November 1892 he had showed the bones to a 'Reporter of the "Advertiser" who published a report in that paper'. Hurst, one of 'several gentlemen' who inspected the specimens, took them to Stirling at the museum. A month later the Register and the Observer announced the appointment of Hurst and Meldrum, as reported in the minutes of the museum committee meeting of 2 December 1892:

The Chairman [Stirling] reported that he and Professor Tate had arranged to send Mr Hurst (formerly of the Queensland Geological Survey) and Mr Meldrum to examine the Diprotodon remains which the latter found near Lake Frome, and to bring away for the Museum what may be worth removal – Mr Hurst to have a fee of £20- and travelling expenses and Mr Meldrum to be paid £3- per week and travelling expenses; any further rewards which they may receive to be dependent on the value of the find.

The chairman reported at the same meeting that Hurst and Meldrum arrived at Leigh's Creek on 30 November and started for 'Lake Frome' the next day. At the next board meeting two weeks later, on Friday 16 December, 'Dr Stirling reported on the arrangements made for examination of the Lake Mulligan fossil remains and their securing by the Museum'. From Hurst's initial reconnaissance, it appeared that the deposit 'appeared to be much larger than was supposed, and that its examination would require a larger party and a much longer time than had been originally contemplated'. The delighted committee agreed to consider the matter of a

3 Anon., 'Arrival of mammoth fossils from Mulligan Lake', South Australian Register, 31 July 1893, 6.
4 John Meldrum (Adelaide) to 'the Chairman, Board of Directors, SA Museum, Public Library & Art Gallery' (Adelaide), 11 January 1894, Callabonna Papers, SAM.
5 Anon., 'Discovery of Diprotodon bones near Lake Frome', South Australian Register, 2 December 1892, 5; Anon., 'Discovery of Diprotodon bones near Lake Frome', Adelaide Observer, 3 December 1892, 31; Museum Committee meeting, minutes, 2 December 1892, Callabonna Papers, SAM, 260-1.
6 Anon., 'Report of Board Meeting, Public Library, Museum and Art Gallery, South Australia', South Australian Register, 21 December 1892, 2.
more extended search. They estimated the cost for a three month stay at £250, which 'with strict economy' from the committee and free transit provided by the Railway Commissioners, they could make available.\(^7\) Hurst and the second excavation party departed Adelaide and arrived at Quorn on 13 January 1893. They left Farina on 20 January, proceeding 200 miles in eight days to Lake Mulligan 'via Mount Lyndhurst, Freeling, Mount Hopeless Creek and Petermorra' (Plate 33). The party consisted of Henry Hurst, his brother George, the well sinker John Meldrum (hired as excavator), 'two labourers and an Afghan'. The unnamed labourers were probably the elder Hurst brother (William, 'a sort of hanger on of the camp')\(^8\) and the other excavator, Templeton.\(^9\)

*Fred sets the story straight*

It took some time for another story of the discovery of the remains to emerge. On 6 July 1893, R W Ragless of Enfield (that Richard Ragless who ran Callabonna in partnership with his younger brother Fred) wrote to the *Register* claiming that his brother F B Ragless discovered the Callabonna fossils '8 years ago' and sent the Museum a Diprotodon jaw. The story as Richard reported it told of them hearing often from 'the natives' about 'big bones' in the lake, 'but it was always thought that they had referred to cattle which had got bogged in crossing'. One day, for some reason left unexplained by Richard, Fred, 'accompanied by a native, visited the scene, and satisfied himself that they were the bones of an extinct animal'.

The elder Ragless seems to have mixed up at least two stories. In 1885, John Ragless sent a Diprotodon jaw to the South Australian Museum, serendipitously found by Fred while sinking a well near the newly built Callabonna homestead, away from the lake bed. It appeared to the pastoralist to be a lone specimen, and he does not seem to have made any organised attempt to search for more bones until 1892, perhaps prompted by Jackie Nolan. Richard wrote in 1893 that 'so long as eight years ago [Fred] found the lower jawbone of the Diprotodon, which specimen is now in the Museum, having been presented to the authorities by Mr John Ragless', and also that 'Mr Meldrum was working on the station at the time, and with other hands saw the

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\(^7\) 'Special meeting of the Museum Committee', Museum Committee minutes, 16 December 1893, Callabonna papers, SAM.

\(^8\) E C Stirling (Adelaide) to 'the Board of Governors of the Public Library &c &c of South Australia', 28 August 1893, marked confidential (private collection of R H Tedford).

\(^9\) Henry Hurst, 'Preliminary report from H Hurst to the Museum Committee', 29 July 1893.
bones brought in, and on the following Sunday took the same native and went to see the place. Mr Meldrum, he says, shortly afterwards left the station and came to town, where he showed the specimens and claimed to be the discoverer. Why it took Meldrum eight years to travel from Callabonna Station to Adelaide with the specimens, Richard left unexplained. Nor did he explain why Fred chose only to send an incomplete lower jaw to the museum in 1885, if the site had been so rich.

Notwithstanding confusion in the reporting of the elder Ragless' letter, by August 1893 the Register credited Fred with the first delivery of Lake Mulligan bones to the South Australian Museum (although the bones he found in 1885 were not from the lake), followed by Mr John Meldrum 'in November last'.

That same month Fred Ragless also wrote to 'disburden the public mind of the impression that Mr Meldrum was the discoverer'. While Meldrum might first have brought 'this subject under the notice of the authorities', Ragless wrote rather sarcastically that 'unless the fact of his having borrowed a horse' from Callabonna Station and followed Fred's tracks to the spot 'eight days after I had been there' would 'entitle him to rank as the discoverer', the well-digger had assuredly not found the fossil site first.

The younger Ragless' story clarified Richard's account, and explained why the busy pastoralists took so long to refute Meldrum's claim to have made the first discovery, despite its long announcement in the Adelaide press:

I first visited the place on Sunday, June 12, 1892, accompanied by a black boy, and after satisfying myself that the remains were not those of either cattle or horses, but of some much larger animal, I secured a few specimens, which I brought in and showed to the men on the station, one of whom was Meldrum. On the following Sunday he, as before stated borrowed a horse from me, and, accompanied by the same black boy, drove out to the same place and brought in the bones, which he some four months afterwards exhibited in Adelaide. I intended visiting Adelaide early in October of 1892, and therefore did not forward my specimens by post, preferring on account of their fragile nature to keep them under my

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10 R W Ragless, Correspondence, South Australian Register, 6 July 1893, 4.
11 Anon., 'Arrival of Mammoth Fossils from Mulligan Lake', South Australian Register, 31 July 1893, 6.
own care until such time as I could take them down. Unfortunately adverse circumstances prevented me leaving the station as early as I intended. I was totally unaware of Meldrum having taken his specimens to Adelaide and was first made cognizant of the fact by the appearance of a report in your paper.

The 'black boy' in this account played a background role, a nameless someone who 'accompanied' first Ragless then Meldrum, rather than led them to the bones.

The paper published a letter the same day from the conveniently incognito "Spotswood, jun." of Callabonna Station which 'fully corroborate[d] Mr F B Ragless's statement'. The correspondent 'saw Mr Ragless in possession of a parcel of the bones prior to Mr Meldrum's visit to the place', adding that Meldrum 'was not at any time prospecting for water within twelve or fourteen miles of the shores of the lake', but after being shown the bones 'he made a special trip to obtain some specimens'. To undermine Meldrum's story further, 'Spotswood, jun.' indicated that no fresh water springs existed within eight miles of the fossils, 'as is evidenced by the fact that the geological party have had to cart all their water with camels during the time they have been in the field'.12 As for 'Jackie Nolan', he remained publicly nameless until Fred recorded his memoir forty years later.

Well before the controversy reached the Adelaide papers, George Goyder, now Surveyor General of South Australia, wrote to Stirling informing him that a Mr F B Ragless of Enfield 'called at this office yesterday [12 December 1892], and stated, that he is the discoverer of the fossil remains at Callabonna Station – four miles s.w. from the Homestead'. Furthermore, Ragless remarked that at that time he employed Meldrum and 'a black really was the discoverer of the bones & showed them to Mr Ragless on the following Sunday who subsequently showed them to Meldrum, also that there are from 12 to 14 specimens'.13

One inference that could be drawn here is that the bones were new to the unnamed 'black', who told Ragless about them as soon as he became aware of them ('on the following Sunday'). This is hardly in keeping with Richard Ragless' admittedly confused account, which had 'the natives' alerting the lessees to the giant bones on the

12 Anon., 'The fossil remains of Lake Mulligan', South Australian Register, 1 August 1893, 5.
13 Surveyor General [G M Goyder] to E C Stirling (addressed to the Adelaide Club), 13 December 1892, Callabonna Papers, SAM.
lake floor for some time 'but it was always thought that they had referred to cattle which had got bogged in crossing'.

Goyder wrote again in July 1893, as Ragless had enquired about his reward. Stirling in reply asked Goyder to assure Ragless that 'No one' any longer disputed 'that to Mr Ragless belongs the credit' and promised to 'take care that any other press reference which emanates from the Museum authorities gives Mr Ragless the credit of the discovery.' He thought it was premature to discuss rewards before the museum established the extent and value of the find but suggested that Ragless 'make a formal application to the Board of Governors that the matter may come officially before them'. Interestingly, neither Stirling nor Ragless at any time referred to a specific reward such as the £1000 purportedly offered by the Museum and the Royal Society of South Australia.

It apparently caused the Ragless brothers some frustration that the press continued to refer to the reportedly duplicitous Meldrum as 'discoverer' well into 1893, and that the Museum rewarded him for 'stealing' the bones with £3 a week to help the excavation. Perhaps some of their later complaints against the Hurst party, and Henry Hurst's hints at the Ragless' broken promises, sprang from resentment over Meldrum's presence in the Museum group, and the drought-threatened pastoralists' unease over the disposition of the much-disputed 'reward'.

It is unclear whether this reward was to be paid for the 'first' complete Diprotodon or for the long-desired Diprotodon feet. Neither is it clear whether it was to be paid to the 'discoverer' or to the first man to bring such remains to Adelaide. The South Australian Museum remains somewhat cagey regarding this matter and has long been reluctant to release papers relating to it. All that is clear is that the institution

14 R W Ragless, Correspondence, South Australian Register, 6 July 1893, 4.
15 [G M Goyder] to E C Stirling, 21 July, 1893, Callabonna Papers, SAM.
16 E C Stirling to the Surveyor General, 24 July, 1893, Callabonna Papers, SAM.
17 For hints of disputes, see Hurst 'Preliminary report ... to the Museum Committee', Callabonna Papers, SAM: 'Mr Ragless who previously promised to lend me a horse, dray and water tank whenever I require them was unable to do so, but offered to hire his bullock dray at £3 per day if I could get a tank elsewhere – not considering this offer sufficiently moderate, I retained 3 camels pending your reply to my request for a further loan of them. Should this request not be granted I shall have to accept the terms of Mr Ragless'. See also Stirling, confidential letter to the Board of Governors, 28 August 1893, Callabonna Papers, SAM. The director claimed that Hurst 'troubled' the Ragless brothers 'by too frequent visits and requests for rations by the party'.
18 Regarding the availability of papers: David Corbett, the Curator of fossils and minerals at the museum in the 1960s, and his assistant June Scrymgour, in consultation with Peter Crowcroft, the
never paid a reward for the discovery of the Callabonna Diprotodons. Hans Mincham visited Fred Ragless at his North Adelaide home in May 1950, shortly before he died. The former pastoralist told him a variant of the oft-published account of Jackie Nolan and the elephant bones. 'He had nothing much to say about the Museum' or the reward, except to say that it was never paid, but he spoke positively of his relationship with E C Stirling. Mincham remembered that Ragless stressed his disapproval of John Meldrum's behaviour, and had no idea what had happened either to the well-digger or to Henry Hurst during the intervening years.

'incompetent to conduct a work of such magnitude'

**The Hurst excavations**

Hurst's reports were initially promising. He requested that the museum seek to finance a much longer collecting expedition to the lake. Stirling put this to the cash-strapped board and eventually Sir Thomas Elder came to the party and provided £500, which kept the party in the field until November 1893. The *Register* and *Observer* in August 1893 reported Elder's contribution and that at the board meeting reported in the *Register* on 28 August (which was actually well after Stirling's return from the lake), the board decided that Stirling, Zietz 'and another' (museum collector Thomas Cornock) would join the excavation, presaging some of the doubts over Hurst's competence that emerged from the director's report of late August. Hurst's career until the South Australian Museum appointment appears to have

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19 Ragless died in the winter of 1953, aged 94 (Hans Mincham, pers. comm., 2 February 2000).
21 Pledge, 'Fossils of the lake', 73.
been patchy. The 'shy, timid young geological collector' had great success collecting for the Queensland Museum on the fossil-rich Darling Downs. During his five years with the museum, from 1887 to 1891, he wrote in 1889 'from Chinchilla that he was returning with "nearly 3000 specimens"'. He received positive feedback and references from C W de Vis, the eminent curator of the museum, both for his prowess as a collector and for his contribution to Queensland's display at the Centennial Exhibition in Melbourne in 1888:

> Important service was rendered the Commissioners for the Centennial Exhibition at Melbourne by another of your officers, Mr H Hurst, who spent a considerable time in arranging the mineral exhibits in the Queensland Court, having, in conjunction with myself, been for some weeks wholly engaged in preparing and cataloguing them for exhibition.  

But the museum dismissed him toward the end of 1891, Hurst 'having abandoned his post – he had disappeared from Brisbane'. In any case, de Vis apparently provided him with good enough references that eighteen months later, having shown initiative bringing Meldrum's specimens to the South Australian Museum, he secured the position leading the Lake Mulligan collecting team.

Far from appearing shy and timid, in print at least Hurst's boldness and enthusiasm for the task could not be faulted. He expressed to Stirling his eagerness to be involved with the later reconstruction and analysis of the bones, his determination that South Australia should have the 'honour' of the discovery of the first complete Diprotodon skeleton, his assessment of the richness of the site, the other megafaunal fossils the group found further afield in the lake. Stirling for his part complained of Hurst's irregularity in communicating with Adelaide. Hurst blamed the inclemency of the weather, which often prevented him leaving camp for Callabonna Station to send

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24 [C W de Vis], 'Annual Report of the Curator', 1.


26 For example, see Henry Hurst (Lake Mulligan) to E C Stirling (Adelaide), 11 March, 16 March, 6 May 1893, Callabonna Papers, SAM.
mail. H Y L Brown visited the site in May 1893 and, although astonished by the lake's prehistoric wealth, wrote an excoriating confidential report to the board, scathing both of the way Hurst ran the camp and the excavation. He was appalled at the state of the exhumed fossils, which he saw exposed to the rain and wind and (where labelled at all) arranged chaotically by bone type rather than individual specimen. Hurst's first trip back to Adelaide in July 1893 aroused Stirling's anxieties further. He had hoped for many more specimens and those that arrived were of a 'varied and miscellaneous character'. Many were much broken. Veiled and not-so-veiled criticism of Hurst began to appear in print.

Hurst blamed the transport by camel across a landscape alternately sandy and boggy, and the difficulty of protecting the fossils in the field. He wrote frequently and enthusiastically to Stirling, in the latter's capacity both as director of the museum and as chairman of the museum committee, requesting more camels to help in the transport of the specimens and in the procuring of rations and packing materials. He also mentioned the problems of the weather – either too hot and dry to keep horses near the camp or too wet for the excavation and packing to progress efficiently. He kept many specimens unpacked in long anticipation of Stirling's visit. Several times, he explained his decision to try to build a composite Diprotodon from the ground up, on the basis of the richness of the field and the probability eventually of unearthing a 'perfect' specimen.

But it seems he and Stirling had different collecting philosophies. Hurst believed that the most important part of his brief was to find or construct a complete Diprotodon, paying especial attention to evidence of the nature of its feet:

We are making good progress towards successfully accomplishing

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27 For example, see Henry Hurst to E C Stirling, 20 June 1893, Callabonna Papers, SAM.

28 See Anon., 'Arrival of mammoth fossils from Mulligan Lake', South Australian Register, 31 July 1893, 6, for complaints that the specimens were 'broken up'. The article suggested that if they were treated 'with better care in the matter of numbering the fossils in the order in which they were found much less labour would be entailed in placing them in position on arrival', thereby averting 'the breaking up of skeletons … and this important field of fossiliferous wealth would be conserved for the benefit of science and the colony'.

29 See Henry Hurst (Lake Mulligan) to E C Stirling (Adelaide), 16 February, 11 March, 16 March, 20 March, 5 April, 6 May, 20 June; see also Hurst, 'Preliminary report … to the Museum Committee', Callabonna Papers, SAM. See also Hurst (Port Augusta) to Stirling (Adelaide), 11 July 1893, en route to Adelaide having left his brother in charge, expressing his concerns about injury to the specimens, which he was forced to transport by horse and buggy, as the camels were not available (Callabonna Papers, SAM).
the main object of the Expedition – South Australia will undoubtedly have the honour of possessing the first complete Diprotodon as we now only require a few bones to make up the total number. The difficult bones are principally ribs and vertebrae and will soon be procured.\textsuperscript{30}

He and his brother George were commercial collectors, freelancing when they had no institutional affiliation, for whom quantity was as important as quality. Although he had a considerable interest in and knowledge of comparative anatomy, Hurst reasoned to Stirling in March that as he had not so far met with 'a skeleton which could be extracted absolutely perfect some portion or other being nearly always found missing', he considered it 'the wiser plan to get one by the quickest means possible'. They were operating to a tight schedule.

So Hurst decided that the most efficient way to assemble a Diprotodon was piecemeal, 'by selecting the bones from a number of animals. At any other site such a method 'would be an impossibility, but here the task is rendered easy through the remains being present in such fabulous numbers – thousands of skeletons are probably buried below'. They sought the 'best' parts from which the museum preparators could fashion a composite whole, waiting all the while to 'find one which is entirely complete in itself' when Hurst would 'take the greatest pains to get it out perfect – This I do not doubt I will do before we have finished'.\textsuperscript{31} It is clear from many of his letters that this is what he had set about doing, but Stirling seems to have missed the implications, for it was not until the first specimens arrived and more particularly after his own visit to the site that his ire was fully aroused:

In place of having in view the great necessity for keeping together and distinguishing the bones of individual specimens, they were evidently indiscriminately mixed together. It was clear that Mr Hurst's unwise attempts to construct perfect skeletons from parts of different animals had led to inextricable mixing of the bones, not only of those of the same species, but probably of those of different

\textsuperscript{30} Henry Hurst (Lake Mulligan) to E C Stirling (Adelaide), 11 March 1893, Callabonna Papers, SAM.

\textsuperscript{31} Hurst to Stirling, 11 March 1893, Callabonna Papers, SAM.
Stirling at Callabonna

Stirling returned to Adelaide at the end of August, announcing that he had left Zietz in charge with Thomas Cornock as his deputy, as the Hurst brothers had 'resigned'. Although disappointed and angry at the progress of the excavation so far, he was impressed with the extent and concentration of the fossil field. He wrote, in a confidential letter to the museum board concerning his own visit to Lake Mulligan that 'careful and repeated examination' of the specimens Hurst brought from the lake 'on the occasion of his recent visit' to Adelaide precipitated the director's journey, having convinced him of three things.

First, Stirling believed that Hurst's 'method of preparation of the bones was not the best that might be used and indeed that it was in some cases actually prejudicial'. Second, the collector's 'system of arrangement and labelling was not to be relied on' and third, his reports were 'unsatisfactory and incomplete'. In addition, 'a report furnished by a reliable authority who visited the locality', probably H Y L Brown, made Stirling suspect that 'the work of excavation was not being wisely conducted'. On the other hand, Hurst's accounts 'incomplete as they were', as well as that of Brown, 'could leave no doubt of the extraordinary richness of the deposit in fossil remains of great variety'.

So the director decided, 'with the approval & at the desire' of the Museum Committee, 'to proceed thither in company with Mr Zietz the Assistant Director & T Cornock, Taxidermist and Articulator'. His intention was 'that if it were found that things were not going on satisfactorily the Museum Officers should remain and take charge of any subsequent operations that might be resolved'. The three men left Adelaide on the morning of Friday 11 August 1893. They reached the camp on 17 August, only one day after Henry Hurst whose return from the city was hampered by a camel accident at Farina, which necessitated his loading two camels with the weight of three. Stirling stayed until the following Monday, 21 August, and reached Adelaide five days later. Zietz, Cornock and the rest of the museum party, minus the Hursts,
returned to Adelaide the following December.35

Stirling was critical of every aspect of Hurst's management of the camp and the excavation. He saw 'on all sides' evidence of 'utter carelessness, slovenliness, and want of system', as valuable bones lay about 'exposed in all directions, some fortunately still in fair condition, while others were irretrievably ruined by exposure and bad treatment'. Of the large number that had been labelled and stored under cover of the tents, Stirling found he could 'attach little value to the accuracy of the labels'. He found the camp 'slovenly in the extreme' with refuse, tools and utensils 'left indiscriminately littered about'. The interiors of the tents 'were disgracefully dirty and untidy – the original stock of cooking utensils were mostly broken or lost'. To cap things off, two bags of plaster of Paris 'had been allowed to be exposed to the rain and were entirely spoiled and although more than 20 boxes were available some four or five only had been packed up' with specimens. He found it 'difficult to imagine the Camp of a scientific Expedition in a more disgraceful condition'.

As far as the excavation itself went, he saw 'a want of method in the plan of operations', as bones which he was convinced 'might have been removed whole' had broken in the course of removal and bones which were 'perhaps … unavoidably broken' had not been kept together for subsequent mending. Most decisive for Stirling was the 'inextricable mixing of the bones', the result of Hurst's 'unwise' attempts to construct complete Diprotodons.36

Not that Stirling was entirely oblivious to the difficulties presented by Lake Mulligan-Callabonna as excavation site. Aside from its undeniable remoteness from sources of provisions and the difficulties of obtaining enough of the invaluable camels, there was the weather, of which Hurst had complained in several letters to the director. It did not take long to make itself known to Stirling. On the evening of 18 August, the day after his arrival, 'rain began and continued all night, so that by next morning the bones, though covered up as well as we could, were too damp to be packed away'. In addition, the 'tenacious clay of the camping ground became also horribly soft and sticky and it was in fact impossible to get satisfactorily on with anything'. By the afternoon of the following day the weather had cleared sufficiently to allow some

35 Stirling, confidential letter to the Board of Governors; Anon., 'Lake Mulligan fossils', South Australian Register, 4 December 1893, 5.
36 Stirling, confidential letter to the Board of Governors.
packing, but the lake bed was 'far too wet to admit of some trial excavations which I intended should be made during my stay'.

He observed that in dry weather 'camels and even buggies can cross the bed of the lake without much difficulty, but a very slight fall of rain renders this a matter of great difficulty'. Since the camp was located 'about two miles from the Eastern, and three miles from the Northern shore', even a slight fall of rain could prove critical for mobility: 'the track ordinarily used to the Eastern side became exceedingly treacherous. In attempting to cross it our Blanchewater buggy got bogged and had to be dug out, and on another occasion a camel [I?] was riding shared the same fate'. So he concluded the body of his attack on Hurst's management with a small proviso:

Whilst therefore I have animadverted somewhat severely upon Mr Hurst's method of management, I fully recognize that in the face of existing difficulties the work of keeping the camp going is, alone, a matter requiring a very considerable amount of management and foresight, to say nothing of the difficulties in dealing with the bones themselves, which require the most careful treatment.37

He did not soften his assessment of Hurst's performance with this qualification. It appeared to Stirling that the collector had throughout 'shown himself to be completely incompetent to conduct a work of such magnitude'. Under his management 'a fraction only of the success which was possible, has been achieved'. Although Stirling acknowledged that the team under Hurst excavated 'a considerable quantity of material, probably when packed up amounting to three tons', he insisted that 'the uncertainty as to the labelling' greatly undermined its value. Furthermore 'Mr Hurst has not yet got a single complete individual skeleton of Diprotodon' and Stirling thought it 'exceedingly unlikely even that a single skeleton can be made up', as 'many important bones, such as the vertebrae' were 'so imperfect and incomplete as to greatly minimize their scientific value'. Regarding other megafauna, he feared that 'the opportunity has been lost of securing bones and portions of bones of other animals of which less even is known than of the Diprotodon'.38

37 Stirling, confidential letter to the Board of Governors.
38 Stirling, confidential letter to the Board of Governors.
It appears that Stirling was as yet unaware of the difficulties involved in preserving Callabonna specimens, which remains a problem at the site. They are impregnated with gypsum (hydrated calcium sulphate), which crystallises when the fossils dry, causing the bones to expand until they explode and fragment. Zietz' party had no more luck than Hurst's.

The site itself, while not redeeming the Hurst brothers, went some way to compensating the museum for the time and money already expended. Stirling told the board that 'in promise of results, the field far surpasses any expectations which previous reports had led me to form of it'. He anticipated that there were 'hundreds or even thousands of skeletons yet untouched and the ground actually explored is but a minute fraction of the whole fossil bearing area'.

He described the successful method used by the Hursts, without crediting them, to find subterranean bones, probing with a wire rod, whereby he 'struck underground skeletons or parts of skeletons about a dozen times in a very short space of time', and he expected that the conduct of subsequent operations, under the methodical and careful Mr Zietz, would 'yield results which in scientific value will far exceed those already obtained'. Accordingly, he 'told Mr Hurst [his] opinion' and 'gave him and his brother … a week's notice in terms of the last agreement signed by him, and desired that the third brother (Wm. Hurst), who had been a sort of hanger on of the camp for the last six weeks, should also leave'.

Stirling told the board that the Hurst brothers decided that 'under the circumstances they would like to go as soon as possible'. To 'facilitate their removal' Stirling 'sent them three camels to take them to Moolawatana whence they were to make their own arrangements'. Henry Hurst asked Stirling 'that he might be allowed to send in his resignation', to which the director assented. Finally, to his great displeasure, Stirling was 'unable to discover some rare bones which I was told had been found'. He implied that the Hursts might have retained them, as it appeared they also kept 'some native weapons which were collected during [their] stay' claiming that these 'belonged to the eldest brother [William] who was not in our employ – and that some birds' eggs found by one of the men shared the same fate'.

39 Stirling, confidential letter to the Board of Governors.
40 Stirling, confidential letter to the Board of Governors.
The museum committee held a special meeting on 31 August to discuss Stirling's visit, at which he summarised his report, which itself borrowed heavily from his expedition journal. He informed them that he had left Zietz in charge with Cornock as his deputy. He retained Meldrum at a reduced rate of pay, and the other excavator Templeton, both of whom he found 'willing obliging and handy'. He had less confidence in the cook, Mayo, 'but as he had just been engaged by Mr. Hurst I kept him on'. Stirling regretted 'the stringency of the measures I have been compelled to take, in the interests of the Museum' and he was disappointed 'in regard to the inadequacy of the results so far achieved to great expenditure into which we have been led by a continued course of mismanagement'. But he assured the board that 'failure in the future to make the best of this extremely important discovery' would compound the sin and 'be humiliating in the extreme to all concerned'. He hoped that 'the value of the future work will redeem the comparative failure of the past efforts to make the best use of a field of extraordinary promise'. He saw no difficulty that could not be surmounted 'with patience, judgment, and foresight, save and except a continuance of wet weather which must completely paralyse all operations'.

The party under command of Amandus Zietz remained at the lake until November 1893, at which point they were indeed driven away by rain, having previously been wracked by drought, rabbit plagues, trachoma and gastric illness caused by dead rabbits in the water supply. The Ragless brothers lasted five years more, but their stock was decimated by drought and dingoes, which had reached plague proportions as the rabbits increased. The letters of resignation from the Hursts do not appear in the Callabonna collection of the Department of Palaeontology of the South Australian Museum.

Contested possibilities

In defence of Henry Hurst

Unsurprisingly, the Hursts did not share Stirling's view of recent history. A half-hearted effort to write Henry out of the story appeared in the Register of 22 March

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41 'Special meeting of the Museum Committee', Museum Committee minutes, 31 August 1893, Callabonna papers, SAM.
42 Stirling, confidential letter to the Board of Governors.
43 Pledge, 'Fossils of the lake', 73.
1894. George Hurst replied in April in a letter to the editor, expressing regret 'that no reference was made to the earlier party in charge of my brother'. However, no hint appeared publicly to suggest anything remiss about the Hurst brothers' 'resignation' or their performance at the lake, aside from an anonymous letter in the Register in June 1893, presumably from Brown, decrying the state of the excavation and implicitly criticising Hurst's management. Otherwise, the museum board kept its concerns and recriminations mostly private.

In 1918 Hurst, then based in Brisbane, wrote to Stirling (who had resigned the directorship in 1913), explaining that he had always felt the director treated him unfairly 'in regard to my services in connection with the discoveries at the Lake'. In the twenty five years since his dismissal, he had visited Zietz more than once and established that 'very little was done after I left the Lake and scarcely any (if at all) specimens were obtained'. Zietz attributed this to 'the specimens crumbling on exposure to the air'. Hurst claimed never to have experienced such a difficulty (unlike most subsequent excavators at Callabonna) owing to the adoption of 'special measures', which he 'again put successfully into practice when on similar work in Europe.'

Indeed Hurst had by his own report spent much time away from Australia, and initially, away from palaeontology:

I dropped out of palæontological work in Australia when I left Lake Callabonna, but subsequently gave it attention in other parts of the World. You might have known more of me had I stayed in Australia but mining matters took me to Western Australia where I made a lucky strike which resulted in my making London my headquarters more or less ever since and from that base, mining has taken me to most countries of the World.

Now the well-travelled and apparently rejuvenated Mr Hurst was 'very keen on making fresh discoveries of Post-Pliocene vertebrates'. His eye turned once more to the Lake Callabonna region as he was 'in a position to locate at once some valuable

44 Anon., 'Fossils from a wilderness and a wilderness of fossils', South Australian Register, 22 March 1894, 6.
45 George Hurst, 'Fossils at Lake Mulligan', Adelaide Observer, 7 April 1894, 22.
46 Anon., 'Complaint about state of the fossils', South Australian Register, 20 June 1893, 4.
finds (from information obtained lately)', certain of ’a successful termination'. Stirling forwarded the letter to Edgar Waite, his successor, who thanked Hurst warmly, but had to inform him that 'there is, at present, no intention on the part of this Museum of further exploring the Lake Callabonna District'.

By 1893 Hurst was an experienced collector and palaeontologist, but he had no experience leading an expedition of the size and logistical requirements of the Lake Mulligan site. His camp and site management might well have been inadequate. But there were many mitigating circumstances beyond his inexperience, as outlined by himself and even by Stirling. At times he showed considerable innovation. Aside from the other two Hursts, the men on his team had no experience as excavators, and Hurst actually showed some initiative in training them. Neville Pledge, curator of vertebrate palaeontology at the South Australian Museum until 2000, recorded that when the expedition reached Lake Mulligan in January 1893, they began digging at the site first found by Meldrum, but the specimens there proved to be 'much decayed'. Instead of attempting to recover them for the museum, Hurst used them to train his inexperienced workers.

As far as Stirling's complaints about the piecemeal attempt to construct a Diprotodon from the parts of many different specimens, Hurst had kept his employer informed of his plans and technique. By ignoring the hints, Stirling gave tacit agreement to his methods. Hurst requested Stirling's presence at the site many times. Brown's visit to the site on 25 May 1893 lasted less than a day and followed several days of light rain which troubled the excavators. The Government Geologist was hardly in a position after such a short visit to assess the circumstances peculiar to Lake Mulligan which might have affected the diggings.

Having been at the lake for five months with essentially no guidance, other than the little Stirling could provide sketchily in several letters, which could take up to a fortnight to reach their recipient, Hurst was hastily summoned to Adelaide, where the museum committee informed him that Stirling and Zietz planned to follow him back. Unhappy with the specimens he brought to Adelaide and with their condition, the

47 Henry Hurst (Brisbane) to Sir E C Stirling (Adelaide), 19 October 1918, with addendum from E R Waite (South Australian Museum, Adelaide) letter 26481, 018/3255 (private collection of R H Tedford).
48 Pledge, 'Fossils of the lake', 69.
49 Hurst, 'Preliminary report … to the Museum Committee', Callabonna Papers, SAM.
board was nonetheless unable to provide him with more camels. He had left the camp in charge of his brother George and his return after about two months in Adelaide or in transit was delayed by a camel accident. He was thus unable finally to tidy the camp in preparation for Stirling's long-anticipated arrival. Brown and Stirling both complained about the 'exposed' specimens at the camp, yet Hurst had written many times to Stirling telling him these were left unpacked 'in anticipation' of the director's visit, for the purpose of showing them to him. In any case, they were drastically short of packing cases.

Clearly Stirling was embarrassed at the progress of excavation at the museum's showpiece. The board needed a good return, with hope of financial as well as intellectual benefits. Adelaide hosted the fifth meeting of the Australasian Association for the Advancement of Science (AAAS) in September 1893. Ralph Tate, with Stirling one of the museum committee members responsible for Hurst's appointment, was president elect. Stirling, and probably Tate, had hoped to have three and perhaps four complete skeletons ready to display at the meeting.50 Perhaps the committee wanted scapegoats, which the Hursts' somewhat unorthodox methods in a difficult environment provided. From 1889-94, Stirling was honorary director of the museum. At the end of 1894 the board elected to pay him a full salary. The anticipation or hope of this might have influenced his behaviour. It was important to him both personally and for the prestige of the institution he led that the investigation of Lake Mulligan-Callabonna proceed smoothly and successfully.

In his enthusiasm for the site and his eagerness to continue excavating, Hurst somewhat naively wrote to Stirling in March telling him that 'The material we now have is worth many hundreds of pounds at the least and I do not think we have got a fractional part of what another 3 months work would yield if we continued the search.' His announcements in April and May that his party had unearthed 'three nearly complete skeletons' together with 'over 2000 separate bones of the same animal belonging to over seventy individuals' raised Stirling's expectations that the museum might assemble a complete specimen before the AAAS meeting.51 His disappointment was therefore disproportionate when Hurst arrived in Adelaide with far fewer

50 Anon., 'The fossil remains of Lake Mulligan', *South Australian Register*, 1 August 1893, 5; Anon., 'Science Association Meeting', *South Australian Register*, 26 August 1893, 4.

51 Anon., 'The discovery of fossil remains at Lake Mulligan', *South Australian Register*, 23 May 1893, 5; Hurst to Stirling, 5 April 1893, Callabonna Papers, SAM.
specimens than anticipated, in poor condition. The director, as Hurst later wrote, did 'not, at the time, fully understanding the peculiar difficulties involved in safely unearthing the Diprotodon, and other bones'.

Paying for the past

It appears the museum did not pay the offered reward (if indeed it ever promised a specific reward) for several reasons. The papers relating to the decisions to offer £1000, or any amount, and whom to pay, are for the most part unavailable. Neville Pledge wrote in 1994 that 'In 1870, a reward of £1000 was offered for the discovery of a complete Diprotodon skeleton', but gave no references or details as to who offered it. In 1893-4 most discussion by the possible recipients of a discoverer's fee involved a reward of unspecified amount.

From what I could gather, the decision not to pay centred around a number of issues and disputes. First, during the depression and drought of the 1890s, the money was not available, particularly given the unexpected expense of excavating at Callabonna. Second, the principal claimants squabbled over priority, allowing the museum to play their claims off against each other. Third, the museum decided no payment was due, under the pretext that no 'complete' Diprotodon had been excavated. The specimens all needed reconstructing, none was perfect, and each was a composite of the bones of several animals. Fourth, the museum dictated the conditions under which a reward was payable, latterly promising only to reward the Raglesses if its own expenses were recouped first. The committee easily dismissed the half-hearted claim of George and Henry Hurst who were after all museum employees at the time. They were not working for themselves, and therefore any specimens they found belonged to the museum anyway. Henry Hurst's delight at being the first scientist to see 'every bone constituting the skeleton of the Diprotodon' availed him not. The committee insisted that a reward could only be paid following the construction of a complete Diprotodon, as distinct from the recovery of all its various disarticulated bits.

Meldrum wrote to the board claiming the prize six months after the Adelaide papers first reported the Ragless claim, referring particularly to a clause in his contract

52 Hurst to Stirling, 19 October 1918, with Waite addendum (private collection of R H Tedford).
53 Pledge, 'Fossils of the lake', 65.
54 Pledge, 'Fossils of the lake', 73.
55 Hurst to Stirling, 11 March 1893, Callabonna Papers, SAM.
that promised him a reward:

it was stated that I was to proceed to Lake Mulligan with Mr Hurst at a weekly remuneration of £3 per week [later reduced to 30/- a week when Zietz took charge] and further should my statements [of several 'carcasses' lying exposed on the lake bed] prove to be correct I was to be highly rewarded … On Mr Zietz taking charge my wages were reduced … but I did not forgo my claim to the reward … it was understood between myself and the Museum authorities that I was to show three complete skeletons only, but instead of which there proved to be many more I think that I have justly established my claim to the reward the amount of which I shall have to leave to the generosity of the Board … as there was no sum stipulated however it distinctly states in the terms of my agreement that I was to be highly rewarded.56

The museum committee in the guise of Stirling sent his letter back to him, annotated. Stirling explained that the board did not recognise Meldrum as discoverer 'but Mr Ragless who sent fossil bones from Callabonna to the Museum as early as 1885', although Ragless found only parts of a lower jaw, which his father sent to Adelaide that year. Furthermore, he found it near the homestead, about two miles east of the lake, far from the fossil site on the lake bed which eventually relinquished a 'complete' specimen.

Stirling insisted that the clause which referred to Meldrum's reward 'was inserted in the agreement on the assumption by Mr Meldrum of a discoverer's claim, proved [or at any rate, asserted by Ragless and the museum] subsequently to be incorrect'. Furthermore, the board intended 'that the payment of £3 a week which was much in excess of the wages paid to any other member of the party in a similar position, should be considered as a sufficient reward for the information Mr Meldrum brought to Adelaide'.57 So much for John Meldrum, out of two jobs with no promise of

56 Museum committee meeting, report, 10 January 1894; John Meldrum to 'the Chairman, Board of Directors, SA Museum', 11 January 1894; Museum committee meeting, report, 2 February 1894, Callabonna papers, SAM.

57 Museum committee meeting, report, 2 February 1894, Callabonna papers, SAM. See also annotations in Stirling's hand on Meldrum to 'the Chairman, Board of Directors …', 11 January 1894, Callabonna Papers, SAM.
a Diprotodon-led recovery.

On the other hand, no documentation exists to prove the Ragless brothers' claim to the lake-bed discovery with any more certainty than Meldrum's. Meldrum stuck to his story well after the Adelaide papers published the Ragless' versions. His letter of January 1894 enquired about his promised reward – not the £1000 reward purportedly offered for the discovery of a complete Diprotodon skeleton, rather an unspecified 'discoverer's claim'. He wrote convincingly that 'during the year 1892' while engaged 'well sinking on Messrs Ragless Bros Callabonna Station' he received 'certain information … from the Natives' which induced him 'to take one of them and explore the Lake for some distance'. Eventually they 'came across the remains of several large animals the bones of which I had never seen before'. He collected as many as he 'could conveniently carry and took them into the Station where they were seen by the men working there'. He 'kept them by' him for 'a couple of months' before bringing them to Adelaide in early November. 58 His story is similar to Fred Ragless account of his own interest in the giant bones, except that Meldrum's reference to learning from 'the Natives' has a generic quality, as if stories of the bones were a commonplace for the Aboriginal people at Callabonna Station.

Fred Ragless' story of his introduction to the bones on the lake bed is both more specific than Meldrum's, and incompatible with Richard Ragless' version. One day, out of the blue, a 'native' told him about giant bones. His subsequent accounts over the months and years became more detailed, culminating in the version in his memoir, written in 1936, of elephants and campfire stories, which introduced 'Jackie Nolan'. Perhaps Meldrum refined his story having read Ragless' account in the Register. But perhaps he told the truth. There is no particular reason that the 'Natives' or 'black boy' of their two versions should have told only one European man of the bones in the lake. Maybe Meldrum had already seen or heard of the bones when Ragless returned, fossil-laden, to the homestead, showing his new collection to the men, and was inspired to ride out himself. Maybe he had already collected the bones and Ragless' return merely provided the catalyst for his trip to Adelaide. Perhaps Meldrum acted in good faith, believing himself the discoverer of the bones. But if the Ragless account is accurate, Meldrum inexplicably held onto the bones for four months before bringing them south.

58 Meldrum to 'the Chairman, Board of Directors …', 11 January 1894, Callabonna Papers, SAM.
Certainly, he is Australian vertebrate palaeontology's main candidate for villainy, for all that he introduced the 'wilderness of fossils' to Adelaide scientific society. The descriptions by twentieth-century vertebrate palaeontologists of founding moments of the discipline in Australia inevitably include a version of the Callabonna story that credits Ragless with the discovery of the bone-yard, qualified with mention of Jackie Nolan's role in leading him there and John Meldrum's cupidity.\(^59\) It suited the museum board better to regard Fred Ragless as the discoverer. Ragless did not have a contract with the museum, with a clause vaguely promising a discoverer's fee.

Fred Ragless was more persistent than either Meldrum or the Hursts. He contacted George Goyder several times, asking the surveyor-general both in print and in person to intervene with Stirling on his behalf. At Stirling's recommendation he wrote to the museum committee claiming to have discovered the bone-yard and asserting his entitlement to any 'honour and reward'.\(^60\) In the drought-stricken north of the colony the Diprotodon money, however little it was, might have been the difference between survival for another year or failure, although it was not until 1899 that the Raglosses finally abandoned Callabonna Station. The museum, initially via Stirling, replied that as Mr Hurst had only brought 'samples of the bones with him leaving the great bulk to be brought back by two teams', it was 'impossible to speak of [the] value' of the specimens gathered from the site.

Perhaps another agenda operated here. Stirling must have been aware from Hurst's correspondence that the Raglosses had not always been as helpful as they had promised to be, and that they had charged prohibitively to store the fossils, to provide Hurst with a dray for carting water, and to bring the specimens south. He told Ragless (via Goyder) that the museum looked to the sale of specimens 'to defray a portion of the expenses but it is impossible to say what we shall have to offer until we know what we have got – their condition and the price we may expect to get'. They had, he claimed, 'said all along, the bones only have a value when they have been appropriately exhumed & taken care of', an expensive task 'almost entirely undertaken by the Museum'.\(^61\) There had been a tendency in the press to equate the fossil find with

\(^{59}\) For example, Mincham, *Vanished Giants*, 41-3; Pledge, 'Fossils of the lake', 68; Vickers-Rich and Archbold, 'Squatters, priests and professors', 28.

\(^{60}\) Museum special committee meeting, report, 31 August 1893, Callabonna papers, SAM.

\(^{61}\) Stirling to the Surveyor General, 24 July 1893, Callabonna Papers, SAM.
the lucrative copper finds in the colony earlier in the century for economic promise. Lake Callabonna was to be the saviour of South Australia as well as its pride. Perhaps the museum board played up this aspect in the hope of attracting more public funding.

Robert Kay replied to Ragless' letter to the board. He thanked the Ragless family for its assistance and acknowledged Fred's 'precedence' and entitlement to any reward, but explained that he was 'not yet in a position to say anything'. As the museum had expended 'a good deal of money in searching for fossils' and 'would probably have to expend a good deal more', it appeared unlikely that 'even when the whole are received', their 'money value' would 'enable the Museum to recoup itself for the Large expenditure it will have been obliged to incur'. He advised that Ragless wait until 'the results of the undertaking are better known'.

Again in 1895 Stirling laid a letter before the museum committee from Ragless, asking if the matter of his reward had been considered. A month later the committee received a memo from the board, which had resolved to tell Ragless that it had no funds from which to reward him 'for the discovery of the fossil deposit at Lake Callabonna'. However it voted to pay the newly salaried director £100 'in settlement of the balance due on his contract with the Board for planning and superintending the arrangement of the new Museum'. No one ever considered paying 'Jackie Nolan'. In 1894, no one even wanted to know his name.

**The recuperative power of the deep past**

The *South Australian Register* rapidly adopted a cabbalistic voice when the first Lake Mulligan bones reached Adelaide, celebrating the region's presumed former lushness, as revealed by its 'mysterious' material remains. In August 1893 the newspaper linked the 'sterile' landscape to the wonder of the deep past: 'the gigantic creatures of a bygone age whose relics are embedded in the hardened mud and débris of what were once the huge swamps of the Far North-East'.

Thirteen months later, another anonymous scribe in the *Register* described the Callabonna site as located in 'a series of "claypans" in the vast desert north-east of

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62 Robert Kay (Adelaide) to F B Ragless (Callabonna Station), 25 September 1895, Callabonna Papers, SAM.
63 Museum committee meeting, report, 5 April 1895, Callabonna Papers, SAM.
64 Museum committee meeting, report, 3 May 1895, Callabonna Papers, SAM.
65 Anon., 'The fossil remains at Lake Mulligan', *South Australian Register*, 12 August 1893, 4.
Farina. It is a "lake" only in flood times – an arid waterless region of sand and salt pools … where even rabbits do not thrive and camels are a necessity'. Ornamenting this scene are 'the bones of monsters' which 'lie as they died', by the hundreds. However, far from contributing to the Hadean character of the site, the bones raised questions which began to recuperate the reputation of the lake environment:

On what did they feed? Why were they made so enormously strong? … What astonishing changes in the climate and rainfall must have occurred since these beasts roamed in the jungle as the rhinoceros, or in swamps as the hippopotamus? … These things are among the buried secrets of the great past, which secrets science is unlocking.66

Again in the Register, in May 1893, the bleakness of Callabonna, 'a more apparently uninteresting and forsaken spot' than which 'could not be found in the whole of Australia', is juxtaposed with a fulsome account of its glorious deep past, as revealed by Science:

A different picture of the past history of this country is brought to light by the new discoveries! [Nearby] Mount Searle [sic] … was probably at the period of which we speak fully twice [its present] elevation. On its sides grew huge trees, and all around was a dense tropical growth, exceeding in luxuriance the forests of the eastern slopes of the Andes in South America. Every form of life on the whole earth was at that time huge and uncouth … [These skeletons] are a magnificent treasure in the interests of science … Of very far-reaching significance is the story which is told by these mute relics of a remote age.67

This discovery 'in the most unexpected' location, 'of incalculable value to science', went some way to redeeming the lake as a functional colonial landscape. At first glance, the story reads as one of degeneration from a Pleistocene Eden to a modern desert. Closer reading shows that value in the modern landscape is clearly attached to the wealth of meaning the bones provide.

66 Anon., 'The fossils from Lake Mulligan', South Australian Register, 12 September 1894, 5.
67 Anon., 'Extinct animals of Australia', South Australian Register, 24 May 1893, 4-5.
In an article in *Nature* in 1894, Stirling dismissed the scenic merits of the lake in unflattering terms as 'Almost unsurpassable for barrenness and utter desolation'. He made reference to names 'such as Mount Hopeless, Dreary Point, Illusion Plains, Mount Deception, Mirage Creek' which invoked the 'character of the surrounding country' in which 'Scarcely any vegetation relieves the prevailing desolation'. As for the lake itself, 'not a bush relieves the unbroken monotony of the level, white crystalline surface'. But he considerably tempered his criticism of the region's sparse severity with the statement that 'There is compensation for the uncompromising physical features' of the lake 'in the fact that its bed has lately been shown to be a veritable necropolis of gigantic extinct Marsupials and Birds, which have apparently died where they lie, literally in hundreds'.

Even at the height of his disappointment with the conduct of the excavation under Henry Hurst, Stirling was convinced that the richness of the lake would eventually compensate the museum fully, in scientific if not economic terms. The site's scientific promise was rooted in Diprotodon feet, tails and epipubic bones – the 'missing' pieces:

The scientific importance of this discovery will be evident from the fact that though frequent discoveries have been made in Australia of bones and teeth of this giant marsupial, which exceeded a rhinoceros in size, no complete skeleton exists in any museum, nor among other missing bones have those of the fore and hind feet ever been discovered. The determination of these will probably throw much light on the as yet little known affinities and habits of this huge beast.

Inspired by the emerging stories of Callabonna Station, Mr James Ward wrote to the *Register* in July 1893 describing the state of the north of the colony 'in earlier times', as told to him 'by a blackfellow at a marshy swamp on the Wilpanara Run in the year 1865'. The Aboriginal man described 'some huge animal that at one time did exist' and which dwarfed a horse, as recalled to him by an older relative. In keeping

68 Stirling, 'Fossil remains', 185-6.
69 Stirling, confidential letter to the Board of Governors.
70 Anon., 1893, 'The discovery of fossil remains at Lake Mulligan', *South Australian Register*, 23 May 1893, 5; *Adelaide Observer*, 27 May 1893, 43.
with Charlie Pierce's description of Gyedarra in Queensland, Ward 'was impressed that if such an animal ever existed, it only frequented marshy places'.

Based on his experiences in the country north of Adelaide, and the advice of the Aboriginal man regarding 'huge animals', he was in no doubt that Lake Mulligan-Callabonna 'has been a large marshy swamp at no greatly distant period'. In support, Ward recalled that 'in or about the year 1855', land 'between the Para River and Virginia was rich and fertile, bearing heavy crops', with 'paddocks of wheat three feet high, and in the black sandy hollows over four feet'. By 1880, the land was comparatively barren 'and the hollows salt lagoons'. Wells in the district sunk by the early residents 'were from forty to fifty feet to the water. In many of them it has risen to within a few feet of the surface and become quite brackish'. Based on the rapidity of change in the landscape, he hypothesised that 'If the sea encroach inland at the head of Spencer's Gulf at the same rate it is probable that in a thousand years hence ships will sail to Lake Torrens'.

Rather than 'the sea encroach[ing]', this letter appears to represent an early account of the salinization of South Australia, with a rising water table and encroaching salt following the extensive land clearance and replacement of native flora with shallow-rooted European crops that accompanied European expansion into the interior of the colony. Ignorant of longer cycles of humidity, aridity, groundwater fluctuations, and of Aboriginal husbandry of the inland, the Callabonna remains evoked a fertile recent past and the promise eventually of a navigable inland sea for James Ward, just as J W Gregory saw the potential salvation of the 'Dead Heart' in its well-watered deep past. Equally, headlines in the Register and Observer implied the former existence of a world where life was bigger and more lush than modern Australia, but the articles hinted at possibilities for contemporary exploitation as well. Once liberated from the 'wilderness' of Mulligan-Callabonna, the fossils gain

71 James Ward, Correspondence, 'Former state of the country', South Australian Register, 21 July 1893, 4.

72 Gregory, The Dead Heart, 342-52.

73 For example, see Anon., 'Extinct animals of Australia', South Australian Register, 24 May 1893, 4-5; Anon., 'Extinct life in Australia', South Australian Register, 1 July 1893, 4-5; James Ward, 'Former state of the country', South Australian Register, 21 July 1893, 4; Anon., 'Diprotodon and its times', South Australian Register, 28 September 1893, 4-5; Anon., 'Mammoth fossils from the interior', South Australian Register, 4 November 1893, 5; B Francis, 'Ivory and the fossil discoveries', South Australian Register, 23 December 1893, 9; Anon., 'Fossils from a wilderness and a wilderness of fossils', South Australian Register, 22 March 1894, 6.
meaning and in turn imbue the lake landscape with potential. Thus fossils and vertebrate palaeontology provide the link in a study of the potential of deep time to replenish and recuperate country which is in other contexts deemed useless or barren.

**South Australian proto-nationalism, intellectual capital and the mobilisation of the deep past**

Richard Owen, international bone collector, named *Diprotodon optatum* in 1838.\(^7^4\) *Optatum* means wish or desire, and in 1877 Owen recorded these words that could be a palaeontologist's manifesto: 'Of no extinct animal of which a passing glimpse, as it were, had thus been caught, did I ever feel more eager to acquire fuller knowledge than this huge marsupial. No chase can equal the excitement of that in which, bit by bit, and year after year, one captures the elements of reconstructing the entire creature of which a single tooth or fragment of bone may have initiated the quest'.\(^7^5\) By the time he died, by now arguably Europe's leading comparative anatomist, most parts of the animal's skeleton had been found and sent to him for identification, but no foot bones had been identified. The anatomist could speculate on Diprotodon-locomotion, but much about its stance remained a mystery. His desideratum was the foot (Plate 32).

In November 1892 Stirling announced the discovery of an abundance of Diprotodon fossils at Mulligan's Lake. In December of the same year Owen died, aged eighty-eight. The year after Owen's death, a cast of a Diprotodon foot was discovered in the sediments of Mulligan's Lake. That same year, in 1893, the first foot bones were found putting to rest any last doubts as to whether it had feet. H Y L Brown returned from the north of the colony in early June, having spent one day at Mulligan-Callabonna. He reported that 'parts of 80 Diprotodon skeletons have been found, including feet and tail, and an impression of the foot with five claws'.\(^7^6\) The identification of its tail bones promised to identify its closest living marsupial relations. As explained in Chapter Nine, Diprotodon foot-bones had in fact been discovered many years before at the Wellington Caves and sent to Owen, but he or his correspondents assigned them to other skeletons.\(^7^7\) Not until the 1870s did Gerard Krefft deduce that some of the mysterious metatarsals and phalanges could belong to

\(^7^4\) Mitchell, *Three Expeditions*, vol 2, 368.

\(^7^5\) Owen, *Researches on ... the Extinct Mammals of Australia*, cited in Mincham, *Vanished Giants*, 39.

\(^7^6\) Anon., 'Remarkable discovery of fossils', *South Australian Register*, 13 June 1893, 5.

\(^7^7\) Tedford, pers. comm., 20 July 2000, New York.
Diprotodon, and his suggestions on the matter were entirely ignored. In any case, how could such a delicate toe belong to this marsupial behemoth? The great advantage of the Callabonna remains, aside from their extent and variety, was that they were found in situ, their articulated legs and feet leaving little doubt as to which bones belonged to which species.

Owen died without recognising the feet right under his nose. But their significance surpasses the narrative twists their discovery invites. Like minerals, fossils were part of the capital of the earth and the wealth of Empire. Colonial authorities saw an opportunity to exploit the new resource, witnessed by the cash reward of £1000 supposedly promised in 1870 by the South Australian Museum, to the first person to present the institutions with a complete Diprotodon skeleton. When the museum and the Adelaide newspapers announced the wealth of the Lake Callabonna finds in 1893, metropolitan scientists anticipated a marsupial windfall. It was not forthcoming. Even during the great palaeontologist's lifetime, his control of the lost worlds of reptilian, avian and mammalian megafauna began to slip, particularly as the astonishing collections of dinosaur bones from America's Midwest became apparent. Following his death, the British Museum of Natural History's hold over Owen's empire of giants crumbled further. Stirling held onto his feet.

Mechanistic models invoking a unidirectional flow of data unmediated by ideology or analysis from the colonial 'periphery' to the metropolitan 'centre', and of knowledge and patronage back from the centre to the periphery have characterised colonial collectors, naturalists and institutions, particularly during the first three quarters of the nineteenth century, as handmaidens to imperial science practised in Britain. In particular, teleological assumptions frequently underlie vertebrate

78 For example, see Curator and Secretary [Gerard Krefft], Australian Museum, to the Colonial Secretary [John Robertson], Sydney, 10 May 1869, No 2584, Shelf 173HG 13.3, Australian Museum Library collection; Krefft to George Bennett, 23 February 1870 [copy], Owen Papers, Krefft; Krefft to Richard Owen, 11 June 1870 [copy], Owen Papers, Kreft.


palaeontologists' accounts of the history of their discipline in Australia and its 'development' from a 'pioneering age of discovery' to the 'future' with its 'unfathomed areas in need of exploration'.

But metropolitan theories and classifications were not formulated in a vacuum. Ditch-diggers, sheep farmers, Aboriginal people, collectors, amateur naturalists and increasingly professional scientists selected which parts of the fossil record made their way to which scientist in Britain, in a chain of serendipity, patronage, decreasing agency and increasing renown, beginning with the coincidence of preservation and discovery.

The timing and extent of the singular Callabonna discovery was fortuitous for the South Australian Museum. The 1893 AAAS meeting was a boon for Adelaide's cultural institutions generally. Although the museum's anatomists, articulators and taxidermists did not have time to assemble a complete Diprotodon in time and Stirling's paper on Diprotodon feet did not appear for another three years, both the meeting and the fossil remains generated a great deal of popular interest, feeding off each other and the consequent media flurry.

Between November 1892 and September 1894, close to sixty items about the Lake Mulligan megafauna appeared in the Register, often with duplicates in the Observer and Advertiser. More than forty of these occurred in 1893. In September 1893, Ralph Tate delivered a lecture to the Royal Society of South Australia on the evidence for climate change offered by the Callabonna remains.81 Also in September Charles de Vis lectured to AAAS attendees on 'the Diprotodon and his times'.82 There was also some popular interest in the fossils overseas. The British Association for the Advancement of Science reported on the remains.83

81 For reports of Tate's lecture see Anon., 'Royal Society of South Australia', South Australian Register, 6 September 1893, 6; Anon., 'Royal Society of South Australia', Advertiser (Adelaide), 6 September 1893.

82 For reports of de Vis' lecture see Anon., 'Australasian Association for the Advancement of Science – forthcoming lecture', Adelaide Observer, 16 September 1893, 16; Anon., 'A science convention', South Australian Register, 25 September 1893, 7; Anon., 'The Diprotodon and its times', South Australian Register, 28 September 1893, 4-5; Anon., 'Diprotodon and its times – a lecture by C W de Vis', Adelaide Observer, 7 October 1893, 33.

83 W Stirling [E? Stirling], 'Note on the discovery of Diprotodon remains in Australia', Report of the British Association for the Advancement of Science 64, 1893, 784.
of Magdalene College Cambridge, describing the Diprotodon's foot-bones.\textsuperscript{84} Reports in the \textit{Scotsman} appeared in late 1893.\textsuperscript{85}

At first glance the Diprotodon's toe may seem to have little to do with South Australian proto-nationalism, parochialism and the commodification of the material remains of the deep past. But as a letter to Stirling from Henry Hurst while the latter was stationed at Callabonna, made clear, 'the main object of the Expedition' as Hurst understood it was that South Australia would 'have the \textit{honour} of possessing the first complete Diprotodon'.\textsuperscript{86} An increasing demand for independence, recognition and specialisation among colonial museum curators and naturalists during the last quarter of the nineteenth century resulted in more aggressive collecting and exchange policies in colonial institutions, epitomised by Gerard Krefft's lament at the inadequacies of metropolitan classifications of Australian fossil material.\textsuperscript{87}

Specimen exchange aided the accumulation of scientific capital. Museums attached considerable cachet to the acquisition of exotic foreign materials. Unearthing duplicate specimens which could be used for exchange with other institutions facilitated this, as in the Callabonna case, and the construction of casts, as museums were loathe to risk the loss of unusual or valuable specimens. As Hurst wrote to Stirling in excitement from the field, requesting more funding to prolong the expedition in light of the unexpected concentration of fossils, 'By the end of the period … I believe there would be enough material to supply a large number of the Museums in the World'.\textsuperscript{88} 'Private interests' speculated in 1893 that the Callabonna fossils would be more lucrative than copper mining or ivory and in 1894 an Adelaide syndicate was floated with the intention of unearthing Callabonna specimens for private profit.\textsuperscript{89}

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\textsuperscript{84} \textit{The Times}, 25 April 1893, unprovenanced clipping, Margaret E Ragless collection; Alfred Newton, 'Palaeontological Discovery in Australia', Letter to the Editor, \textit{Nature} 47, 27 April, 1893, 606. Newton's letter reported his receipt of a telegram from Stirling on 21 April.

\textsuperscript{85} Reported in Anon., 'Fossil remains of Lake Mulligan', \textit{South Australian Register}, 1 November 1893, 5.

\textsuperscript{86} Henry Hurst to Edward Charles Stirling, 11 March 1893, Callabonna Papers, SAM, Adelaide.


\textsuperscript{88} Henry Hurst to E C Stirling, 16 March 1893, Callabonna Papers, SAM, Adelaide.

\textsuperscript{89} Anon., 'Arrival of mammoth fossils from Mulligan Lake', \textit{South Australian Register} (31 July 1893), 6. See also B Francis, Correspondence, 'Ivory and the fossil discoveries', \textit{South Australian Register} (23
Henry Hurst at the very least would have approved of such a proposal, continuing to Stirling in his letter of 16 March that "It would be a great pity to suspend operations so hastily as it is now proved … that there is a great possibility of more valuable discoveries'. He speculated optimistically that 'The material we now have is worth many hundreds of pounds' and he did 'not think we have got a fractional part of what another 3 months work would yield if we continued the search'.

Stirling and the museum guarded their intellectual capital. For example, in his article in *Nature* in 1894, Stirling wrote cagily that 'Of the feet, in which from our previous ignorance of their constitution much interest is centred, I prefer not saying much at present'. Contrary to mid-century trends, the director and Amandus Zietz described most of the specimens themselves and published their most significant findings in the *Transactions and Memoirs* of the Royal Society of South Australia before more prestigious overseas journals, despite the interest from abroad as well as within the colony. The director met correspondence from the British Museum requesting samples with firm apologies. He explained that it was impossible to transport the skulls without risking irreparable damage and many of the other fossils were not fit to travel. To prove his goodwill and the patriotism of the museum board he was willing to trade some metatarsals and maybe a clavicle. But in the interests of science and all their institutions, he advised waiting until the museum had got 'all the parts accurately represented' and a cast of the whole might be available.

The board was reluctant to allow scientists from other states and institutions untrammeled access to the site, as discovered by J W Gregory when he plotted his demented summer field trip in 1901-2.

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90 Hurst to Stirling, 16 March 1893, Callabonna Papers, SAM, Adelaide.
91 For example, Stirling, 'Fossil remains', 209.
92 Between 1894 and 1914 Stirling's and Zietz' papers on the fossil remains of Lake Callabonna appeared in the Royal Society of South Australian publications. Stirling also published a preliminary account of the Diprotodon bones and the Callabonna site in *Nature* in 1894 (Stirling, 'Fossil remains').
93 E C Stirling (Adelaide Museum) to Professor E Ray Lankester (British Museum, London), 14 February 1899, Callabonna Papers, SAM, Adelaide.
94 Gregory, *Dead Heart*. Also correspondence between J W Gregory, A H C Zietz and the South Australian museum board from September to December 1901, Callabonna Papers, SAM, Adelaide.
had discovered that Callabonna 'was a proclaimed reserve of your Museum' he had 'thought better' of making it the main feature of the field trip, which had been his initial intention. But he was still eager to collect at the famous site and asked Zietz accordingly if there would be 'any objection to my going … for a week or two's collecting' during the return trek from Lake Eyre to Melbourne. He hoped during his time in the Lake Eyre basin 'to collect, or try to collect some bones, and get a general idea of the structure of that country' where the Pleistocene remains were found in such great variety and number. He also looked to compare the 'desert conditions' with those of Africa, where he had found 'bone deposits' forming around dried waterholes, in a clear comparison with Callabonna.  

Zietz wrote to the museum board that he did 'not think that he could hurt us, if he should carry out his intended visit'. Nonetheless, protective of the museum's intellectual interests, he advised 'that Prof. Gregory be informed that owing to Prof. Stirling's absence you would not like to take any steps in his favour' and thus 'it would be necessary to wait for his return about the middle of November'. Gregory replied, thanked Zietz for the information and suggested that he would only go to Callabonna 'for purposes of comparison' with Lake Eyre, which he found much more interesting, but should be glad of permission from the museum trustees to visit and collect at the site all the same. He tried carefully to reassure the board that of course he 'would not do anything to forestall the work of the SA Museum in publication over Callabonna'.

The trustees gave only grudging permission to the Melbourne expedition to collect at Callabonna, although the museum had not sent a collecting party there itself for eight years. Gregory wrote to thank them, but impatient with the museum's jealous provincialism, he added that as the Lake Eyre basin, 'to me the most interesting area in Central Australia', held quite enough attractions, he would most likely return to the west and bypass Callabonna altogether, as indeed he did.

It was for these reasons of intellectual ownership and the control of meaning, as much as to protect the site from amateur rock hounds who might damage it and entrepreneurs who might exploit it, that the fossil reserve was first proposed by H Y L

95 J W Gregory (University of Melbourne) to A H C Zietz (Adelaide Museum), 14 September 1901, Callabonna Papers, SAM, Adelaide.
96 Gregory to Zietz, 2 October 1901, Callabonna Papers, SAM, Adelaide.
97 J W Gregory (University of Melbourne) to 'the Director of the S. Australian Museum' [E C Stirling], 1 December 1901, Callabonna Papers, SAM, Adelaide.
Brown in 1893. He declared that the site afforded
[scientific] opportunities which have seldom before occurred on this
continent, and which may not occur again. The work now being
done by the Adelaide Museum in collecting specimens will
doubtless lead to the settlement of many points … In view of the
importance of preserving these relics of a bygone age for the future
scientific exploration, I would recommend that the whole area … be
reserved for that purpose, and to prevent the indiscriminate digging
up and removal of portions of the specimens.98

Requests for Callabonna fossils were made by institutions as far apart as Perth,
London, Cape Town and Brazil.99 Eventually the museum distributed seven casts of
the 'complete' Diprotodon skeleton along with bones of extinct kangaroos, giant
wombats and Genyornis, the giant flightless bird first identified from Callabonna
remains, in exchange for such exotica as black monkeys (Colobus Guereza),
mummies, stuffed 'mammalian heads' and leg bones of the dinosaur, diplodocus.100

The popular significance of Lake Callabonna emerges primarily from the
whisper of former worlds provided by its dirt and fossils, material remains crucial to
the reconstruction of the deep past in South Australia. As information was literally and
serendipitously unearthed in colonial Australia, cultural institutions began to build up
indigenous collections, retaining duplicates for trade with other institutions. The roles
of patron and client were further destabilised.

Stories of the material remains of Lake Mulligan-Callabonna's former worlds
and their intellectual heritage continue to shed light on the perception of fossils as a
mineral commodity, and on the importance of intellectual capital in late colonial
museums in Australia. These stories intrude into the socio-political history of the
colony/state. In 1893 (and again in 1953-4 and 1970) scientists, journalists, legislators
and their audiences mobilised conceptions of the deep past, its material remains and
intellectual legacy to insert Mulligan-Callabonna into their collective 'proto-national'

98 H Y L Brown, 'Fossil Bones Near Callabonna Station', South Australian Register (1 July 1893), 6.
99 Assorted correspondence on museum exchanges and reports of the museum board in the South Australian Register in Box 3, Folder 9 and Box 2, Folder 1, AA 309, SAM, Adelaide; Callabonna Papers, SAM, Adelaide; E S Booth Papers, State Library of South Australia, Adelaide.
100 A H C Zietz (Adelaide Museum) to E C Stirling (England), May 1901; Zietz to Stirling, 15 March 1901, Box 2, Folder 1, AA 309, SAM, Adelaide; Pledge, 'Fossils of the Lake', 75.
or parochial identity as a place worth saving. In turn, the prehistory represented by the lake landscapes and material remains connected (and continues to connect) South Australia's (and South Australians') lineage with a nebulous, global deep past.
Chapter XII

Finding Lake Callabonna again, 1913-1970

Losing Lake Callabonna

Before the revelation of its palaeontological 'wealth', Lake Mulligan-Callabonna was chiefly renowned as the easternmost shore of Eyre's immense, imaginary horseshoe lake of impassable salt flats and mud. After Babbage, Warburton and A C Gregory atomised the great 'Lake Torrens' and Lake Mulligan entered pastoral and cartographic consciousness, still its principal attraction lay in its distance from the wheat frontier. Notwithstanding Fred Ragless' evocation of 'blazing parakela' and 'flowering winter herbage', Gregory's tag – 'sterile and of little practical value' – stuck.¹

When John Meldrum brought his collection of bones to Adelaide in 1892, the Adelaide press and scientific community rapidly incorporated the site into a canon of significant places. Stirling and Zietz published their last papers on the Callabonna remains twenty years later in 1913, as parts 4 and 5 of the Memoirs of the Royal Society of South Australia.² Stirling died in 1919 and his obituary in the society's Transactions devoted some detail to his work on Callabonna.³ The museum continued to accord limited celebrity to the composite Diprotodon skeleton, whose cast for many years graced the entrance room of the Australian wing of the South Australian Museum until displaced by a whale skeleton. Since 2001 it has been partially reinstated in the Australian Fossil Gallery of the refurbished museum, and the National Museum of Australia in Canberra also has a cast, of the same composite skeleton, in its 'Tangled Destinies' gallery.

But the museum excavation team left the lake in November 1893 and never returned. Lake Callabonna itself lay largely unconsidered by

¹ Memorandum by A C Gregory on the provincial division of the northern portion of the Australian continent, from Votes and Proceedings of the Queensland Parliament, 1861. Quoted in Cumpston, Augustus Gregory, 117; Ragless, 'Seventy years ago'.
palaeontologists for sixty years. In September and October of 1916, Edgar Waite, Stirling's successor as director of the South Australian Museum, led an expedition to the Strzelecki and Cooper Creeks, taking advantage of the collecting opportunities presented by the drought of 1913-15. Although the lake was not part of his collecting itinerary, he passed close by, leaving a dammingly brief record of the 'encrusted and barren area', evocative of Eyre's, Sturt's and Augustus Gregory's earlier descriptions of an inhospitable, charmless, useless landscape. Waite declared his passage to Mt Hopeless Station 'the most dreary country it has been my lot to traverse', reflecting that it is no wonder Eyre 'bestowed such a name – no tree, no bush, no water; and we had difficulty in scraping up sufficient material for fire to boil the billy'. The following day saw no relief: the party 'reached a waterhole and later the crossing between Lakes Blanche and Callabonna, all dry'. In 1918 Waite informed Henry Hurst that the museum had no further interest in the Lake Callabonna site.

This second 'loss' was largely climatically and economically determined – somehow different from the indifference, misunderstanding, misrepresentation and neglect of the earlier nineteenth century. In 1928, a quarter of a century after the museum team under Zietz abandoned the site to dead rabbits and sand, Robert Bedford of South Australia's privately operated Kyancutta Museum visited the area seeking Diprotodon remains. During the 1940s a team from the South Australian Museum attempted to gain the fossil site but, hindered by weather, did not reach it. In 1945, the Australian Museum's Harold Fletcher – accompanied by the fossil collectors George Alder and Frank Foster, respectively a tank-sinker from Broken Hill and a government livestock inspector stationed at Tibooburra – went 'West of the Darling' in search of fossils, and picked up a Diprotodon jaw on Lake Callabonna's floor, although they did not visit the Zietz site of 1893. Once 'discovered' in 1892, the idea of the lake continued to entice and frustrate, with its 'aura of mystery' as Fletcher called it, the half-promise in the 'desolate

4 E R Waite, 'Results of the South Australian Museum Expedition to Strzelecki and Cooper Creeks, September and October 1916', Transactions of the Royal Society of South Australia 41, 1917, 407.
5 Hurst to Stirling, 19 October 1918, with addendum from E R Waite (South Australian Museum, Adelaide), (private collection of R H Tedford).
6 Pledge, 'Fossils of the lake', 75; Fletcher, 'Delving into the past', 148-53.
'Splendid prospects'
Six decades after the South Australian Museum packed up its fossil menagerie, the lake was a successful port of call for the Berkeley palaeontologist and Fulbright Scholar Ruben Stirton and his student Dick Tedford on their first trip to Australia in 1953, coincidentally the year that Fred Ragless died. Stirton, whose name became inextricably linked to Callabonna in the annals of South Australian science, is credited with inspiring a renaissance in the study of vertebrate palaeontology in Australia in the 1950s. For some time he had been actively seeking funding for

an idea which I have had in the back of my mind … the possibility of finding fossil mammalian remains on continental Australia that would throw some light on the origin of the Monotremes, and their relationship to the mammal-like reptiles … I have had unusual success in Colombia with a similar project in cooperation with their Geological Survey … and if we do find fossil remains of early Tertiary Monotremes and Marsupials, it should be one of the most important discoveries that has ever been made in mammalian paleontology.

Advised by Sir Douglas Mawson that 'we should find Tertiary mammals east of Lake Eyre if they could be found anywhere on the continent', Stirton decided to begin with the Lake Eyre, Strzelecki and Tirari Desert regions.

He followed in the turn-of-century camel-prints of H Y L Brown, who surveyed the Lake Eyre region in 1892-3 and 1894, and of J W Gregory who took a group of his students on a whirlwind palaeontological field trip in the summer

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7 Fletcher, 'Delving into the past', 150-2.
9 R A Stirton to Whitney H Shepardson, the Dominions and Colonial Fund of the Carnegie Corporation, 20 December, 1948 (University of California Museum of Vertebrate Palaeontology collection, UC Berkeley [hereafter UCMP Collection]).
Neither expedition returned with identifiably Tertiary mammal remains but based on a combination of his Colombian experience and contemporary geological commonsense, Stirton believed that the former lakes and creek beds of the region showed promise. As he wrote to one of a number of potential funding bodies the following year in the hope of continuing the success of 1953, Australia had 'been a large continental mass for so long' that it was 'only reasonable to assume that somewhere in the interior we should find badlands of continental deposits (river, lake, and floodplain formations) with fossil bones of mammals'.

On the 1953 excursion, they also travelled to the Menindee Lakes on the Darling River to investigate the South Australian Museum ethnologist and polymath Norman Tindale's discovery of extinct megafaunal remains in possible conjunction with human artefacts and burials, and to Lake Callabonna, both trips at the request of the museum, and in exchange for labour and a truck (Plate 20).

But although the two Quaternary sites offered 'splendid prospects', Stirton was primarily concerned to disclose some of the little-known marsupial assemblages of Tertiary Australia. The more widespread and studied Quaternary remains of Callabonna and Menindee held less intellectual interest for the Texan palaeontologist, who dreamed of trying his luck 'at opening the door to a new field of research and to unravel a history of life that scientists have speculated on for a century':

It took considerable time and much discouraging prospecting to find the key to our problem, [despite] in the interim [discovering] the presence of gigantic extinct marsupials in human cultural levels [at the Menindee Lakes], and [rediscovering] the famous Diprotodon (marsupial the size of a

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11 H Y L Brown, 'Annual report of the Government Geologist for the year ended June 30th 1894', *Parliamentary Papers of South Australia* 25 (Adelaide: Government Printer, 1894), 7-8; Gregory, *The Dead Heart*.
12 R A Stirton to the Max C Fleischmann Foundation of Nevada, 6 January 1954 (UCMP Collection).
14 Stirton, Field journal 1953, 18 February 1953.
rhinoceros) locality at Lake Callabonna ... [Our] later explorations along the Cooper's Creek east of lake Eyre were of much greater significance. 

Before returning from Australia in 1953 he wrote to the eminent Berkeley palaeontologist Charles L Camp that 'the last trip of course is far more important than the other two'. In a similar vein if somewhat more bluntly, Dick Tedford later wrote that, notwithstanding the success and interest of the Callabonna and Menindee expeditions, their nine month stay as Fulbright scholars 'had come within ten days of being a complete failure'.

'we hit bone'

Despite the suggestion that the Menindee and Callabonna localities provided something of a consolation prize, Stirton's excitement is palpable in the accounts of his discovery of the original fossil locality at Callabonna, untouched by scientists for nearly sixty years and still incredibly rich in remains. When he first set eyes on the lake in May 1953, and rediscovered Hurst's and Zietz' 1893 camp the desolation of the surface barely raised a comment. The nonchalant explorer-geologist with an eye for detail was making science:

I finally wandered back on the lake floor and came into the high dune ... I could see saline flats island-ward from the dune before I reached it ... Off to my left I saw an object that looked like a box-board. So I strolled over that way ... I then came upon a kangaroo skeleton that commanded my attention for a few minutes as I looked for the cranium and mandibles. We have been picking up the best ones ... Next I saw some forked posts about half buried that seemed to form the uprights for a shelter. All this and other objects about rather convinced me that I had found Zietz' [sic] camp site. Then I thought,

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16 Quote from R A Stirton to the Max C Fleischmann Foundation, 6 January 1954 (UCMP Collection). See also Stirton, 'Digging Down Under', 6, and R A Stirton to Charles L Camp, 19 August 1953 (UCMP Collection).
17 Tedford, 'The Stirton years', 40.
18 For example, see Stirton, 'Digging Down Under', 7-8; Stirton, Field journal 1953, 1 June 1953.
'[Diprotodon] must be about'. In the water and at the edges of
the water were objects that could be what we had been looking
for, within 5 minutes I had located the weathered remains of 9
Diprotodon skeletons.19

Perhaps his equanimity derived partly from the expedition's mode of
transport, by Landrover and truck instead of camel, and from his experiences of
similarly rugged conditions in field camps in the United States, Central and South
America, but the rigours of a one month journey were still considerable. The
landscape provided compensation. He had rediscovered a site of great
contemporary significance and palaeontological wealth, against the predictions of
his colleagues at the South Australian Museum:

It is almost fantastic to think that so many of these creatures
bogged down here … At present we have no idea how many …
It was a cheerful bunch that sauntered their way back to the
Landrover and finally to camp … Paul [Lawson] said that most
of the people around the museum really thought we wouldn't
find the place. Others had looked for it and failed.20

Although in Australia principally to search for the elusive Tertiary
remains, Stirton's joy in discovery, even of these 'young' fossils, is unmistakable
in the journal: 'we hit bone and by evening had uncovered several vertebrae, ribs,
two scapulae and most of the cranium. It is a pleasure to give a field number to a
fossil'.21 The landscape featured only in so far as it thwarted or facilitated science.
It intruded as a mild inconvenience, a recalcitrant container unwilling to
relinquish palaeontological knowledge: 'The mud is so sticky it is a fight to get it
off the shovel … the water had seeped in again and we were standing in slush and
water half way up our shoes … It is difficult to get close to the water because of
the soft mud'. The fossils and the traces of past scientific endeavour were both
features of the landscape – 'My favourite place is on the femur of a partly eroded
Diprotodon exposed at the water's edge' – and measures of its stability – 'It was in

19 Stirton, Field journal 1953, 31 May 1953.
20 Stirton, Field journal 1953, 1 June 1953.
21 Stirton, Field journal 1953, 1 June 1953.
a mound like this that I found one of the whiskey jars indicating [the] stability [of the mounds] for as long as 50 years'. Tedford was equally impressed, after Stirton surprised him, Woodard and Lawson with his discovery:

The scene that lay before us was fantastic – there was Stirling and Zietz island camp – bottles, pottery, whiskey jugs, wood – were everywhere – and around this camp were the fossils that had made Callabonna famous in Australian VP – the gigantic Diprotodon – 9 skeletons lay before us in this saline waterhole only about 50 yards long – many more were to be seen in the flats north of the old campsite untouched in 60 years!22

Recuperation and rehearsal in an 'heroic age' of geology

Despite their prominent place among the first five Memoirs of the Royal Society of South Australia, in 1953 Stirton, Tedford and the University of Adelaide geologists seemed unaware of Stirling's and Zietz' monographs on the 'other' Lake Callabonna fauna – the remains of Phascolonus gigas, the giant wombat, and of Genyornis newtoni, the giant ground bird.23 The 1953 expedition found only Diprotodon fossils, though plenty of rabbit skeletons.

In 1958 Stirton wrote in some surprise that his attention had been directed to 'a large Sthenurus [giant short-faced browsing kangaroo] cranium in the old Stirling Zeitz [sic] collection from Lake Callabonna … Evidently the Stirling-Zietz party found a site or sites where they discovered many things besides Diprotodon'.24 The cranium had not been prepared or described and was 'in rather poor shape but I believe we can prepare it. Dr Bryan Dailey [sic] offered to let me ship it back to Berkeley for its preparation and description'.

The preparation, preservation, identification, construction and publication of the Diprotodon, Phascolonus, and Genyornis remains evidently took so much

22 Tedford, Field journal 1953, Part One, 15 March – 29 June 1953, entry for May 31. 'VP' is vertebrate palaeontology.


24 R A Stirton, Field journal 1958, South Australia, 14 June 1958.
time – in fact twenty years – and money that Stirling decided not to prepare or describe the sthenurine remains. In 1894 he had still hoped to do so, writing in *Nature* of the kangaroos that 'we have one small but very complete skeleton, and a large series of separate bones of several larger kinds, including a fairly compete skull'.

Given the historical consciousness usually well-developed in vertebrate palaeontologists, it is surprising that no one at the museum or university directed Stirton's attention to the presence of other fauna at Callabonna until 1958. Perhaps they forgot, distracted by the peculiarly homogeneous assemblage at the Zietz-Stirton campsite, which produced great quantities of Diprotodon but no other megafaunal remains. The promise of other types of Pleistocene fossils inspired plans for a 1958 expedition to Callabonna. This was cancelled in favour of a promising Tertiary site at Lake Ngapakaldia in the Lake Eyre Basin, where on 25 July, Stirton recorded with excitement the unprecedented discovery of a Tertiary diprotodontid fauna which was 'as abundant here if not more so than Diprotodon was at Lake Callabonna' (Plate 20).

Stirton still lived in an 'heroic age' of vertebrate palaeontology. He saw himself and his colleagues as explorer-scientists, in the mould of men like Douglas Mawson and J W Gregory. He hoped his initial work in Australia would be 'responsible for rapid strides in the development of vertebrate palaeontology and continental stratigraphy in that fascinating land that still challenges the exploring scientist'. In 1955 he wrote to Herbert Hale, then the Director of the South Australian Museum, that he longed to be rid of his chair in Vertebrate Palaeontology at Berkeley to concentrate on research and field work.

'Stumbling' across *The Dead Heart* in 'an Adelaide library', the 1958 expedition followed partly in Gregory's footsteps along the Cooper and Warburton rivers. Stirton's sense of history infuses the account in his journal: 'Upstream from where J W Gregory reported encountering a sandstone' the party came to 'Wara[l]amanka Waterhole, where Gregory's party weathered a sand

25 Stirling, 'Fossil remains', 209.
28 R A Stirton (Berkeley) to H M Hale (Adelaide), 28 June 1955 (UCMP Collection).
storm followed by rain. Our weather is somewhat similar. Sand is blowing everywhere with showers from time to time'.

Charles Sturt, writing in 1840, could have anticipated Stirton's sentiments regarding the Australian Tertiary record a century later, when he wrote of a different but related field of endeavour in Australia ('Geographical exploration') that 'there is still a field for the ambitious to tread. Over the centre of this mighty continent there hangs a veil which the most enterprising might be proud to raise'. Stirton even evoked some of the same imagery, writing of his desire 'to unveil the origin and succession of mammals … one of Australia's greatest secrets'. He had 'dreamed for twenty years' of the Australian fossils, and conceived the 1953 trip while working on the Tertiary record of Colombia. His journal entry for 14 February 1953, the day he arrived in Sydney, expressed his relief and excitement: 'At last I had gotten to Australia in my quest for the ancestry of the monotremes and marsupials'.

**Pedagogy and scientific imperialism**

Despite my reservations about the universal applicability of George Basalla's model of the spread of western science, the 'Berkeley connection' to South Australian palaeontology actually vindicates him to some extent, highlighting the importance of power relations between the palaeontological periphery and a new scientific metropolis. The ascendancy of North American universities and of the United States as an imperial power during the twentieth century saw a corresponding rise in patronage in the 1940s and 50s. The world became a site for knowledge to feed back into the US academy. However, Stirton saw an important part of his mission as fostering vertebrate palaeontology in Adelaide and the rest of Australia, as well as fact- and fossil-gathering for the University of California. His self-assigned task in Australia was broader than a simple palaeontological treasure-hunt to fill in some of the missing pieces in the record of the descent of

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30 Sturt quoted in Eyre, *Expeditions of Discovery*, vol 1, 8.

31 Stirton, 'Digging Down Under', 11, 4. Letters from 1948 demonstrate a long-standing interest in Australia's fossil marsupial record, and its links to his Columbia project. See R A Stirton to Whitney H Shepardson (Carnegie Corporation), 30 December 1948; and Annie M Alexander (a benefactor of the UC Museum of Paleontology and keen amateur palaeontologist) to R A Stirton, 21 December 1948, on 'the Australian project', (UCMP Collection).

32 Stirton, Field journal 1953, 14 February 1953.
mammals. He sought to stimulate research in mammalian palaeontology and foster closer trans-Pacific, cross-institutional ties.\textsuperscript{33}

With his pedagogical mission in mind, he gave public lectures, visited schools and spoke to the press. For example, in September 1954 he delivered a lecture to the Queensland Division of the Geological Society of Australia and the Field Naturalists' Club on 'The giant fossil marsupials of Queensland'.\textsuperscript{34} From his arrival in Adelaide in February 1953, he tolerated the constant media attention: 'Yesterday they took our pictures for the paper ... Today I was asked to give a recording for broadcasting. It will be good when all this is done with'.\textsuperscript{35} He was pleased to note on his return from Lake Callabonna in 1953 that 'Everyone asks me about Diprotodons. Apparently they are talking about it in most of the schools'.\textsuperscript{36} In a letter of May 1955 to Dick and Beth Tedford (the sweetheart Tedford met in Adelaide two years earlier, and married) in Oahu, where Tedford was stationed for his National Service, Stirton mentioned giving three seminars and three lectures on Australia during one week at the University of Michigan.\textsuperscript{37} He also lectured on 'his Australian discoveries' in South Africa and the United Kingdom in 1958.\textsuperscript{38}

He was a mentor to Australian geology graduates such as Geoff Woodard, who accompanied Stirton, Tedford and Lawson on the 1953 expeditions, and who subsequently received funding to complete his doctorate in vertebrate palaeontology at UC Berkeley. He brought American graduates to work on Australian material, such as Tedford and Les Marcus. He also found funding for Paul Lawson and others to study at the Museum of Vertebrate Palaeontology at Berkeley (UCMP).\textsuperscript{39}

He spent some time in 1957 in Washington DC at the National Museum (Smithsonian Institution) compiling a list of Holocene marsupials for comparison

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\textsuperscript{33} Stirton, Field journal 1954, [?] June 1954. [p 42]
\textsuperscript{34} R A Stirton, Notebook 1, 1954, Australia, 24 August 1954, unpublished TS (UCMP Collection).
\textsuperscript{35} Stirton, Field journal 1953, 18 February 1953.
\textsuperscript{36} Stirton, Field journal 1953, 8 July 1953.
\textsuperscript{37} R A Stirton (Berkeley) to Mr and Mrs R H Tedford (Oahu), [?] May 1955 (UCMP Collection).
\textsuperscript{38} Anon., [title unknown], Advertiser (Adelaide), 14 June 1958, 4, newspaper clipping, Callabonna papers, SAM.
\textsuperscript{39} Paul Lawson, pers comm., 19 March 2001.
\end{flushleft}
with the fossil specimens the UCMP teams brought back from Australia. He returned most of the type specimens obtained on the Lake Eyre expeditions to the South Australian Museum and the University of Adelaide, after examining them and taking casts at Berkeley, because he regarded it as important that local institutions retain such important fossils. In 1957 at a conference at the National Museum he recorded his desire to influence the Adelaide scientific establishment to 'do something serious for the future of Vertebrate Palaeontology' in South Australia:

In the early afternoon I ran into C [sic] [Reg?] Sprigg from Adelaide. I tried to bring him up to date on our activities 'Down Under'. He promised to try to influence the 'powers that be' in South Australia to do something serious for the future of Vertebrate Palaeontology. He also said he would help us establish a camp somewhere between the Coopers and the Warburton.40

Of course Stirton was not the only mammalian palaeontologist working on Tertiary remains in Australia, but he was certainly the most prominent and, despite his professed discomfort with interviews, an excellent science communicator and promoter. As well as facilitating the work of Americans on Australian material and vice versa, he collaborated closely with Australian workers in Australia, for instance Edmund Gill of the Museum of Victoria, who did early work on radiocarbon dating. Australian palaeontologists like W D L Ride were beginning to re-assess Tertiary mammalian material during the 1950s and 1960s, and Ernest Lundelius, then a recent doctoral graduate from the University of Chicago, was independently looking at the Western Australian and Nullarbor records.

We can thus see the emergence of a trans-Pacific palaeontological cognitive community, centred around the University of California connection and facilitated by that first cooperative venture between the South Australian Museum and the UC Museum of Palaeontology's Fulbright-funded expedition to

40 R A Stirton, 'Notes on Australian fossils in various museum collections', 1957, item 5: Notes on a conference at the National Museum of the United States of America (Smithsonian Institution), Washington DC, 3 November 1957 (UCMP Collection).
Callabonna in 1953. Stirton was committed to Australian vertebrate palaeontology in the long term. The serendipitous discovery of Tertiary koala remains at Lake Palankarinna by Geoff Woodard on 27 July 1953 was 'the first link in the chain of discoveries that should be followed through the next fifty years' (Plae 3).41 Fifty years later, nearly four decades after his premature death, the 'chain' is indeed still being 'followed through', thanks in no small part to Stirton's legacy.

When Dick Tedford revisited Callabonna in 1970 after an interval of nearly two decades, the fate of Pleistocene megafauna was back on the intellectual agenda for American palaeontologists. The Smithsonian Institution, in the process of revising its fossil vertebrate collections, had funding for a 'Gallery of Pleistocene Giants' from across the world. So with the aid of a National Science Foundation Grant, it financed an expedition to Callabonna in collaboration with the American Museum of Natural History (AMNH) in New York where Tedford was by then curator of vertebrate palaeontology and the South Australian Museum. The 'official' acronym of the partnership was 'SIAM'.42 Although funding fell short of the eventual requirements for reconstruction and display, the expedition itself returned a bumper crop of extinct megafaunal remains and, as with the earlier expeditions to the lake, excited much media coverage in Adelaide.43 The AMNH has a cast of one of two complete skeletons of giant wombats (*Phascolonus gigas*), recovered from the 1970 expedition to Callabonna displayed in its gallery of extinct mammals (Plate 35). There are no complete casts of this animal displayed in Australian institutions.

The South Australian Museum achieved Professor Owen's desideratum – a complete Diprotodon skeleton – posthumously in 1906. But there is an epilogue to the story of Lake Callabonna's Diprotodon graveyard. Not until nearly seventy years later, when 12-year-old Kerry Hine found an undeformed skull at her

41 Stirton, 'Digging Down Under', 11.
father's clay quarry at Bacchus Marsh in Victoria (also the site of Permo-
Carboniferous glacial remains like those at Hallett Cove) did the last, loose thread
of the palaeontological tapestry knit into place (Plate 20).44

44 John Long and Brian Mackness, 'Studies of the Late Cainozoic diprotodontid marsupials of
Australia: 4. The Bacchus Marsh Diprotodonts - geology, sedimentology and taphonomy', Records
of the South Australian Museum 27, 1994, 95.
Skeletons in the cabinet and the lost world of Lake Callabonna

What do stories about Diprotodon bones, dirt and the history of vertebrate palaeontology tell about the way the earth sciences are 'made'? As at Hallett Cove, the multiplicity of geological heritages at Lake Callabonna begins in stories, read in each other, in the landscape and in its fossil productions: geological heritage as earth history, painstakingly reconstructed by palaeoclimatologists, geologists and palaeontologists from its piles of dirt and lumps of bone; and as the history of vertebrate palaeontology embedded in its landforms, in its rescued skeletons and in its archive of field notes, anecdotes, borrowed ethnography and photographs. But the 'third layer of significance' at Lake Callabonna is not a battle between conservation and development. While the fight for Hallett Cove was a test-case for the geological heritage movement in South Australia and has become emblematic of a perceived paradigmatic shift in environmental policy in the state during the 1960s and 70s, public contest has not marred the frosted gypsum surface of Callabonna for a hundred years. Unambiguously an entrapment site and in any case long supposed to pre-date human occupation of the interior by up to a thousand centuries, it rarely impinges on the often fiery contemporary debates about the causes of the extinction of the Australian megafauna.¹

Its desiccated landscape illustrates the redemptive power of deep time and palaeoenvironmental reconstruction in a different way from Hallett Cove. In its evocation of dying Diprotodons in a dying lake, the standard palaeontological Just So Story refreshes the trope of the watered inland in a Cainozoic land of plenty, reiterated in the Willandra Lakes story in Part Three. The interpretation of the material remains of Callabonna's Pleistocene past gives the modern landscape layers of meaning otherwise unintelligible and unimaginable.

Fieldwork takes on different meanings at Callabonna and Hallett Cove.

¹ Although Rod Wells (email, 5 February 2004) observed that he has always estimated their age at a relatively young 70-75,000 years before the present. Furthermore, 'John Magee estimates the age of the sediments directly beneath the fossils at 75-80 ka by analogy with the chronosequence at L.Eyre'. This still places them well outside the standard 45,000 year estimate for the oldest human remains found in Australia to date.
The slippage between laboratory and site are differently nuanced. The South Australian Museum collections can stand in for and replace the physical site at Callabonna. The pragmatics of distance, collection and preparation ensure that it remains a lode to be mined, not a museum or teaching resource in its own right as Hallett Cove is. But the lake itself and its bones have a mystique lacking in the everyday utilitarianism of Hallett Cove's readily accessible outdoor laboratory. This mystique cannot be divorced from its scientific value and interpretation, suggesting that geology can be harnessed in the development of a landscape aesthetic appropriate to flat, dry northeastern South Australia.

Geological heritage management is a poorly-funded, barely legislated process of balancing the often competing needs of heritage preservation and the extractive sciences: custodianship versus interference. The Geological Society of South Australia designated Lake Callabonna and certain other sites in the Lake Eyre basin, like Lakes Palankarinna and Ngapakaldia, 'Classical Sites' for their association with the development and articulation of matters of palaeontological and palaeobiogeographical concern in Australia.² This sits uneasily with Tedford's and Stirton's accounts of major excavations at Lakes Palankarinna and Ngapakaldia, and speculation about the future productivity of Callabonna. The scientists are blasé in print about ripping tons of sediments from the lakes' surfaces in the interest of the science. For instance, Stirton speculated in 1958 after finishing up for the season at Ngapakaldia that 'Much more could be found there by removing something like four feet of overburden, down to the mudstone. This could be done with a slip behind a landrover'.³ Tedford's photographs in his essays in Kadimakara and Vertebrate Palaeontology of Australasia demonstrate the scale of excavations during the 1960s (Plate 36).

Much of this tension is more apparent in National Parks and World Heritage areas, where scientists and NPWS staff occasionally find themselves in conflict. Mike Archer, a vertebrate palaeontologist and most recently the Director of the Australian Museum, was the subject of less than favourable press having used gelignite to remove overburden at the Riversleigh World Heritage fossil site.

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in Queensland in 2001. Palaeontologists at Naracoorte, Riversleigh's South Australian partner, are sometimes frustrated by National Parks' officials who demand detailed reports before they are allowed to excavate. In turn, NPWS staff are anxious that landforms not be destroyed or compromised 'needlessly'.

Work at Callabonna has been erratic, due to its isolation from Adelaide and the nature of the sediments and climate there, although of course this isolation provides a form of protection as well. The inaccessibility of sites such as Callabonna adds an extra dimension to site management in remote areas. Isolation does not always offer enough protection, as witnessed by the illegal removal of valuable Precambrian fossils from the Ediacara site in the remote Flinders Ranges since the 1960s, and other thefts north of Broome. The bones at Callabonna are very difficult to extract, the problem of their post-excavation preservation has not been solved and the region is nearly impassable during anything but the driest season. But its decoding has a genealogy reflecting international intellectual trends, patronage, parochialism and switching allegiances, both personal and national. The desiccated landscape is beguiling, with this tantalising history, its palaeontological and palaeobotanical richness and the eerie vision of the behemoths of the marsupial world trekking across the surface and dying in droves.

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PLATE 18. Boundary of the Lake Callabonna Fossil Reserve, South Australia.
PLATE 19. Diprotodon cast, held in the American Museum of Natural History, mounted from casts prepared by the South Australian Museum.

PLATE 20. Locality Map. Vertebrate palaeontology fossil localities mentioned in the text.
Lancefield Swamp ('Mount Macedon site'), Lake Colongulac, Bacchus Marsh (Vic), Lake Eyre region, Cooper Creek, Strzelecki Creek, Warburton River (SA), Wellington Caves, Menindee Lakes (NSW), Darling Downs, Diamantina River (Qld), Base map from John Mulvaney and Johan Kamminga, 1999, *Prehistory of Australia* (Sydney: Allen & Unwin).

PLATE 22. Language boundaries in the Flinders Ranges and inland lakes regions.
Adapted from David Horton (ed), 1994, *The Encyclopaedia of Aboriginal Australia*, 2 vols
(Canberra: Australian Institute of Aboriginal and Torres Strait Islander Studies).

The right branch of the red line marks a portion of Charles Sturt's 1844-6 expedition.

Extract from John Arrowsmith, 1845, 'Map of Mr Eyre's routes into Central Australia, and overland from Adelaide to King George's Sound, 1840-1', in Edward John Eyre, Journals of Expeditions of Discovery into Central Australia, and Overland from Adelaide to King George's Sound, in the years 1840-1... 2 vols and maps (London: T & W Boone).
PLATE 24. Map of Eyre's horseshoe 'Lake Torrens' (see highlighted area).

Map also shows Charles Sturt's expeditions in Central and south eastern Australia.

Extract from John Arrowsmith, 1849, 'Map of Capt Sturt's route from Adelaide into the centre of Australia, constructed from his original protractions, and other official documents', in Charles Sturt, Narrative of an Expedition into Central Australia, 2 vols and map (London: T & W Boone).
PLATE 25. Engraving of Charles Sturt's party reaching the eastern shore of 'Lake Torrens' (now Lake Blanche).

(Charles Sturt, *Narrative of an Expedition into Central Australia*, 2 vols and map [London: T & W Boone]).

PLATE 27. 'A giant sea found under WA outback'.

Plate 28. Frederick Ragless localities in South Australia.
Adapted from Margaret E Ragless, 1988, *Dust Storms in China Teacups: Ragless Family Heritage to Australia* (Adelaide: Investigator Press).


Highlighted figures are Diprotodon teeth.

Part Three – Dirt, bones and the Diprotodons of Lake Callabonna
PLATE 30. 'Entrance to the largest cavern, Wellington Caves'.

PLATE 31. Lancefield Swamp, Victoria.
This canonical vertebrate fossil locality is now the site of a BMX track and racecourse (photo K Douglas).
PLATE 32. Restoration of *Diprotodon australis* Owen.

PLATE 33. South Australian Museum expedition to Lake Callabonna in 1893.

A. 'View, looking south-west, showing part of the flat saline expanse of Lake Callabonna, with the western shore just visible as a dark streak. The elevation in the foreground is the top of the sand-dune at the foot of which, on the further side, somewhat to the right of the erect figure, the camp was situated. The vegetation is stubby samphire (Salicornia). The bulk of the fossils were obtained on the flat to the right of the erect figure on the sand-dune'.

B. Surface Diprotodon skeleton highlighted in foreground of lower photograph. Its head points to the left.

(Photos and caption from E C Stirling and A H C Zietz, 1899, 'Fossil remains of Lake Callabonna, Part I...', Memoirs of the Royal Society of South Australia, 1[1]).
PLATE 34. Map showing route of J W Gregory's summer expedition to the 'Dead Heart' of 1901-2.
(From Richard H Tedford and R T Wells, 1990, 'Pleistocene deposits and fossil vertebrates from the "Dead Heart of Australia"', Memoirs of the Queensland Museum 28[1]).
PLATE 35 *Phascolonus Gigas* specimen in the American Museum of Natural History, New York (photo R Fraser).
Part Four

Lake Mungo, human antiquity and the watered inland:
Reading 'the scripture of the landscape'

Most people think that Australian archaeology began in 1969 at Lake Mungo.

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Prelude

Beginnings

Beginning One: Jim Bowler: The journey that was to change my life

I undertook an extensive survey of lake and dune systems across southern Australia. From the south-west of Western Australia (the site of many lunette lakes) through western and northern Victoria, the journey led me to western New South Wales … It was there that I first saw the chain of lakes strung out like beads along the now defunct channel of the Lachlan catchment's Willandra Billabong Creek … In fierce heat and dust … I set out with a field assistant, Roger Houston, travelling from Canberra via Hillston on the journey that was to change my life … Working our way south, we first encountered what later became 'Lake Mungo' through Zanci Station on Sunday, February 18th, 1968. Our first encounter with the mysterious 'Walls of China' was a captivating one … It was amazing to find, in this arid land, abundant shells of freshwater mussels, bones of fish and beaches with shoreline gravels, dramatic evidence of times very different from those of today …

Returning to camp at Mungo on the evening of Monday, July 15th, 1968 … I observed some strange bone fragments. Showing obvious signs of having been burnt, the bones were protruding from an eroding deposit of cement-like soil carbonate … As recorded in my notes that day, they provided the first in situ evidence of human occupation predating the age of ancient soil formation …

My first reaction was to dig it out and return the evidence to Canberra. Second thoughts dictated otherwise. My charter was geology and environment; this fell directly into the field of archaeology with all the sensitivities that involved.²

Beginning Two: Jim Bowler: The very presence of humanity itself

1969, a party set out from Canberra in three vehicles, comprising a group of geomorphologists, pedologists and archaeologists … Rhys Jones, lifting apart some of the loosely held carbonate blocks, disclosed from beneath the base of a large chunk, an unmistakable human mandible. We were confronted, not simply by evidence of human activity, but by the very presence of humanity itself. The drama of Lake Mungo had begun in earnest.³

Beginning Three: Australian Heritage Commission: Surely the hallmarks of mankind
The close inter-connection between research into landforms and pedogenesis, palaeochemistry, climatology, archaeology, archaeomagnetism, radiocarbon dating, palaeoecology and faunal extinction, represents a classic landmark in Pleistocene research in the Pacific and Australasian area. … Part of the environmental heritage value of this region is that it serves as a palaeoclimatic reference base … it offers virtually unmodified landscapes for paleoclimatic investigation [and] contributes to the reconstruction of global environmental conditions …

[The] skeletal remains provide amongst the earliest evidence of Homo sapiens anywhere in the world and establish the great antiquity of Australian Aborigines. … An aesthetic sense, ritual, and concern for deceased kin are surely the hallmarks of mankind. The Willandra discoveries have established the great antiquity and richness of Aboriginal culture and have caused a significant reassessment of Aboriginal prehistory and its place in the history of modern man. The discoveries have linked the origins of modern society in the Old World with one across Wallace's line in Australia.⁴

Beginning Four: The mother of all her people
The 27,000-year-old bones of Mungo woman came home on Saturday, back to the dunes where she was found in 1969. The scattered descendants of the Paakantji, Mathi Mathi and Ngiampaa –

³ Bowler, Lake Mungo: Window to Australia's Past.
her people – welcomed her back with tears of joy.

There were tears, too, from some of the white people. Mr Alec Barnes, whose life was irrevocably changed by the discovery of Mungo woman's bones on his property, did not trust himself to speak …

Mungo woman was merely the first to be discovered at what is now recognised as Australia's richest site for the study of human evolution and prehistory.

Indeed, Lake Mungo may have no peer anywhere for unravelling the complex history of modern humans.

Black Australians abhor this clinical dissection of their prehistory. They say they have always been here – and with at least 50,000 years of tangible evidence to back that claim, it is not easily denied …

But when an Australian National University archaeologist, Dr Alan Thorne, handed over the remains of Mungo woman to the assembled elders … a new mood was palpable.

It was an act of reconciliation, of contrition. Mungo woman's remains were returned, after 23 years, with respect and humility, and received with gratitude …

[Her] remains were sealed in a large safe decorated with an Aboriginal painting that depicts her as the mother of all her people.5

David Horton wrote in 1991 that the popular conception of Australian archaeology beginning 'in 1969 at Lake Mungo' is flawed. But he did not unpack the assumption underlying the statement, that the dry lake in the middle of the Willandra Lakes chain, Australia's most famous archaeological site, is little more than a photogenic graveyard (Plate 37). The Willandra Lakes region, since Jim Bowler's discovery of ancient human remains in the 1960s, has certainly come to represent for the popular press a fertile site for beginnings, a desiccated Garden of Eden. Unquestionably it has provided rich intellectual pickings. And as the passages above show, its most famous human relic personifies for Indigenous people of the region a beginning and a link with their land.

5 Graeme O'Neill, 'Mungo woman returns to her people', Age (Melbourne), 13 January 1992, 1.
In the absence as yet of any evidence for conclusively older human occupation of Australia, it is tempting to indulge the powerful symbolism of the ancient burial Mungo 3 (Mungo Man) as an Australian Adam and of Mungo 1 (Mungo Lady or Mungo Woman) as Eve. Perhaps Deucalion, son of Prometheus, and his wife Pyrrha, provide an even more resonant analogy, casting stones over their shoulders on the slopes of Mount Parnassus after the retreat of the floodwaters to renew the human race and with it usher in a new golden age of archaeology in Australia. But in scientific terms, the region is as notable for its non-human relics and landforms, and what they represent in terms of climate change during the Pleistocene, as it is for its headline-grabbing, mythopoeic archaeological remains.

The four passages above, and the device of 'beginnings', illustrate a number of recurrent and contrasting, often inimical, interests and themes which intersect in the stories of the Willandra Lakes region. The first two 'beginnings' are selections from the geomorphologist Jim Bowler's words, explaining in the first instance the interest in dry lake systems which preceded his examination of the Willandra Lakes. This led to his felicitous discovery in 1968 of the Pleistocene human cremation, later known as Lake Mungo 1, and its subsequent field identification as a gracile human female the next year by John Mulvaney, Rhys Jones and Harry Allen, archaeologists from the Australian National University. The third beginning is an extract from the successful nomination by the Australian Heritage Commission of the Willandra Lakes Region for inclusion in the World Heritage List, in 1980. The area was inscribed on the list in 1981. The fourth beginning is from a report in the Melbourne Age of the 'handback' of 'Mungo Lady' (Mungo 1) by Alan Thorne, a physical anthropologist, acting on behalf of Australian prehistorians, to a group of Aboriginal elders at Lake Mungo on 11 January 1992.

That promise of a watered inland, either in the past or an unknown present, which led Bowler to the Willandra system has been rehearsed by scientists and explorers throughout the history of European and scientific exploration of the arid interior of Australia. When Charles Sturt and Thomas Mitchell travelled through – or in the case of Sturt, rowed past – this country between the Lachlan and the Darling rivers, they saw in the arid landforms signs of past inundation. In common with the Mediterranean obsessions of many of their fellow explorers, from Joseph Banks and

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Matthew Flinders to E J Eyre, they misread signs pointing to the existence of an inland sea, and hoped against the evidence for navigable rivers. But their interpretation of the geomorphology and palaeontology of the region as supporting models of former immersion resonates with modern palaeoclimatic and geological orthodoxies.

These models suggest alternating arid and humid regimes in the area during the Pleistocene as ice sheets in the northern hemisphere waxed and waned, and point to the retreat of the sea during the Pliocene, which until perhaps a few million years ago lapped against the Western Plains of New South Wales. In this sense, the 'palaeoclimatic reference base' offered by the lake landforms continues a tradition of field interpretation which sees landscapes as encrypted text books, or 'scripture', from which deep histories and palaeo-climates can be deciphered, and the 'complex history of modern humans' can be 'unravelled'.

The intellectual promise of the country is clear in Bowler's observation that 'It was amazing to find, in this arid land, abundant shells of freshwater mussels, bones of fish and beaches with shoreline gravels, dramatic evidence of times very different from those of today'. (Plate 38) His statement describes a region of contrast and boundaries: a dry place shaped by water; 'lake beds' awash in wind-blown dust and saltbush; freshwater mussels and fish bones embedded in desert sands. Its fragile landforms provide an index of climate change and landscape stability over tens of millennia. The poster-child for human antiquity in Australia was, until twenty-five years ago, a working farm. 'Deep time' at Lake Mungo sits close to the surface, scoured out by wind and rain. Bones buried for millennia are exposed in minutes by wind or washed away by torrential downpours. World Heritage listing offers protection and funding to a site of great significance to Indigenous Australians, but it also links 'the origins of modern society in the Old World with one across Wallace's line in Australia': it is local and global in its intellectual ramifications. This region that has 'established the great antiquity and richness of Aboriginal culture' and 'caused a significant reassessment of Aboriginal prehistory' is thereby appropriated nationally and internationally as part of a project to preserve and catalogue sites of global heritage significance, often against the wishes of the Indigenous custodians.

It is a place of demarcation. Bowler hints at one such line in the sand: 'My

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7 For a reflection on parallels between nineteenth-century biblical and late twentieth-century secular scientific visions of the watered inland of New South Wales, see my discussion in Kirsty Douglas, 'Scarcey any water on its surface', in Words for Country: Landscape and Language in Australia, eds Tim Bonyhady and Tom Griffiths (Sydney: University of New South Wales Press, 2002), 68-83.
charter was geology and environment; this fell directly into the field of archaeology with all the sensitivities that involved. The geomorphologist was still licking his wounds after heavy criticism from parts of the archaeological community, following his involvement in the Green Gully excavation of 1967. He elaborated during a conversation in May 1999, explaining that his first reports from the Willandra Lakes of dates of 30,000 years on mussel shells 'were greeted sceptically'. He was told that it was 'beyond belief' that the shells were human artefacts. Bowler, however, was 'convinced the shells had been carried into the dune by humans', but he 'was not an archaeologist', and it was suggested he go back and 'find something that was more credible'.

The discovery then of those bones 'sticking out of a lump of calcrete' which 'were the bones of a large mammal and they were burned and they were smashed' provided conclusive evidence of human presence for Bowler. But, when working in the Keilor terraces west of Melbourne with Tom Darragh and Dermot Casey 'only a couple of years before', the two latter had removed skeletal material from Green Gully 'and we were chastised' for removing these materials 'without "proper" authentication'. Having 'had my fingers burnt', Jim was unwilling to bring 'unauthenticated' remains back from the lake without their being 'seen by archaeologists in situ'. So Mungo Lady's bones 'lay awaiting expert appraisal' until excavated and identified by archaeologists.

The needs of Aboriginal people and of scientists also come into conflict, as in 1988 when the Western Regional Land Council placed an embargo on archaeological excavation at Lake Mungo. A path to partial reconciliation of such apparently incompatible world views is illuminated by 'beginning four', with the repatriation of Mungo Lady in 1992. Those who believe ancestors belong in the ground and those who believe that knowledge of the dead belongs to all mankind, or at least to those who are prepared to excavate and publish, came together on a day in January that year, when a physical anthropologist handed the bundle of bones to local elders from Balranald, who now store her in a secret 'keeping place', from which she can be retrieved at some unspecified future time for 'further study'.

The compulsory acquisition of Mungo Station from Albert and Venda Barnes for the creation of the Lake Mungo National Park in the 1970s represents another line in the sand, between archaeologists, pastoralists and Aboriginal people. The scientists who uncover skeletal material, haphazardly or systematically, and the Indigenous people

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8 Jim Bowler, pers. comm., 26 April 1999.
who might then claim it and the land on which it is found, are a source of anxiety. Many pastoralists now live in fear that the discovery of human remains on their leasehold will lead to similar reclamation.

Part Four of this thesis is about the interpretation, use and management of signs of age in the landscape, be they human or otherwise. The Willandra Lakes are as important for what they tell us about arid glaciation and landscape responses to climate change as for what they reveal about the human past, although it is the human past that provided the legislative inducement for their formal protection. Their particular significance arises from the striking conjunction of evidence for human presence and for climate change during the terminal Pleistocene. Chapter Thirteen, 'Land and people', is about ways of knowing these landscapes: how people have understood, valued and represented them. Chapter Fourteen, 'Fossils and people', looks at 'fossil' landscapes and human fossils, and ways in which value and antiquity in the landscape are encoded in moveable material objects like human remains. The rest of this prelude introduces the Willandra Lakes World Heritage Area more generally, flagging the major themes to follow, which broadly speaking relate to the disposition of the material remains of the human past, human antiquity and public science, geological heritage, cultural property and national identity.

The Willandra Lakes World Heritage Area
The Willandra Lakes World Heritage Area can be read as a place of boundaries or interfaces. The now dry lakes lie at an ecological interface, between the mallee-covered linear dune fields of the western Riverine Plain, formed principally by aeolian (wind) processes, and the fluvial (river) landscapes of the eastern Riverine Plain. Essentially dry for upward of the last 12,000 years, sited on a long-ineffectual outlier of the Lachlan River, the Willandra Billabong Creek, these 'lakes' embody a geomorphic-semantic contradiction. Their surface expression has been carved as much by wind as by rain and rivers, their sediments influenced by subsurface hydrological regimes as much as meteoric water (Plate 37).

The area is also at a number of cultural and intellectual interfaces. Since Bowler, then a doctoral student in geomorphology at the Australian National University, decided in the late 1960s to investigate the lakes' potential as palaeoclimatic indicators for the Quaternary period, they have come to represent 'windows' onto a more humid, climatically variable past, in dramatic counterpoint to the apparently timeless and
changeless semi-arid modern landscape. The lake and lake shore sediments preserve evidence of cyclical climatic changes between wet and dry regimes over the last several hundred thousand years as ice sheets waxed and waned elsewhere, vividly demonstrating the contradiction of arid, iceless 'glaciation' in low latitude, low altitude Pleistocene Australia. The flora, fossil fauna and artefacts of Aboriginal occupation record patterns of fire and flood, drought and river-flow for a hundred or a hundred thousand years. On a shorter time scale, the lakes display the impact of agriculture, pastoralism, introduced pests, and catchment and groundwater changes relating to water management and irrigation since European settlement.

In July 1968, due to a combination of serendipity and a sharp eye resulting from his eagerness to support a conviction of Pleistocene human occupation of the lake shore, Jim Bowler climbed off his motorbike to investigate a bundle of cracked, charred, carbonate-encrusted bones in a disintegrating calcrete block, belonging he thought to a large vertebrate. The following autumn an excited group of earth scientists, including archaeologists Allen, Jones and Mulvaney, identified the bones as a human cremation and packed them into Mulvaney's suitcase to be radiocarbon-dated at the Australian National University; Mungo Lady made her national debut; and the time of Aboriginal occupation of the continent deepened once more, to 25-32,000 years before the present. In February 1974, in another felicitous conjunction of pluvial denudation and Bowler's motorbike, the exhumation of Mungo 3, or Mungo Man – the oldest recognised ritual burial in the world – pushed Aboriginal occupation of the southeast back to the limit of carbon dating and confirmed Lake Mungo's status as a canonical archaeological location.

In 1979 Mungo Station was dedicated as a National Park which in 1984 incorporated the Zanci pastoral lease. The lakes' investiture as a World Heritage area occurred in 1981, and the boundaries were redistributed in 1995. In 1992 the federal government gave Mungo lady for safe-keeping to Aboriginal people who claim descent from her contemporaries. More mild controversy surrounded the re-dating of Mungo 3 in 1998 and 1999 to anything between 45 and 80 thousand years. The answers to the


question of human origins and longevity in Australia have ramifications for such geological debates as the megafaunal extinction debate and the multi-regional variation hypothesis adopted by Alan Thorne to explain morphological differences between Pleistocene Australian human populations. It seems that age matters in western New South Wales.

Chapter XIII

Land and people – Arid glaciation and the land of lakes

The Willandra Lakes World Heritage Area demonstrates at least forty thousand years of human exploitation. Thirty-two pastoral leases controlled by the Western Lands Commission lie partly or wholly within the region. It has been avoided, maligned, farmed, ignored, named, photographed, painted and studied. Stories have been told about it. Its eponymous lake basins are regarded as 'fossil'. What does this mean? What does 'lake' mean in such a context?

The title of this chapter encapsulates the idea of the region as a land of great contrast – semantic as well as physical and historical. This 'land of lakes' is dusty country on the semi-arid fringe separating the mallee dunefields and the eastern Riverine Plains of New South Wales. Its 'lakes' are mostly ovoid clay and sandy plains, with sparse salsolaceous vegetation. Sheep, kangaroos, emus and feral goats traverse their floors, treading down shells and the bones of fish. Its landforms helped geomorphologists and climatologists articulate a new understanding of the nature of the Pleistocene ice age in low latitude, low altitude mainland Australia, a non-glaciated 'glacial' period that resulted in counter-intuitive, dusty, cold aridity, as the deserts expanded, the lakes dried and the oceans shrank.

Berriait or Barindji

Little has been written about the people who lived in the Willandra Lakes region at the time of and immediately prior to European settlement. Their history must be extrapolated from the limited observations of early settlers and explorers who, like Sturt and Mitchell, recorded their encounters with and speculations about the people they encountered nearby. A L P Cameron, a local landholder, spent time with the people of the Riverine region between the Murray, Darling, Lachlan and Murrumbidgee Rivers in the second half of the nineteenth century. He identified the Berriait or Barindji group as the people inland of the rivers. Cameron wrote that 'bari' or 'beri' means scrub or rough country, although Norman Tindale recorded the Barindji as the 'people of the trees'.1 In 1904, A W Howitt wrote of these groups and their land, 'a large extent of country,

1 A L P Cameron, 'Notes on some tribes of New South Wales', Journal of the Royal Anthropological Institute of Great Britain and Ireland 14(4) 1885, 346-7; David Horton, ed., The Encyclopaedia of Aboriginal Australia (Canberra: Australian Institute of Aboriginal and Torres Strait Islander Studies, 1994), 96; N B Tindale, Aboriginal Tribes of Australia: Their Terrain, Environmental Controls, Distribution, Limits and Proper Names (Canberra: ANU Press, 1974).
without any permanent water, between the Darling, Murray, and Murrumbidgee Rivers', that, when surface water failed, they

obtained a supply from the Mallee, a species of Eucalypt, and from one of the Hakeas. At times of drought they were forced to go to the rivers for water, and as these were occupied by other tribes such as the Barkinji and the Wonghibon, they had to fight their way in strong parties.²

Cameron explained that they had a powerful sense of their separate identity from the river people, despite close similarities in language between the Berriait and the Barkindji of the Murray-Darling system: 'I suggested to my informants that they were part of the same tribe [as the Barkindji], but they would not hear of it'.³ He noted that their method for extracting water from hakea and mallee sustained them for four to five months every year.⁴ It seems they had moved from the Willandra Lakes area by the time Gol Gol Station was subdivided and the Mungo and Zanci leaseholds were established for soldier settlers in 1922.

In his 1972 doctoral thesis on man and land in the Darling basin, Harry Allen, then a doctoral student in prehistory at the ANU, explained that funerary rites on the Murray River as reported in the nineteenth century shared similarities with those of the exhumed Mungo remains, suggesting an unprecedented degree of cultural continuity over time. Interestingly, Thomas Mitchell recorded details of burial sites along the Lachlan, Bogan, Murrumbidgee, Murray and Darling Rivers in 1835-6, noting much variety, but he reported no sign of cremation.⁵ Allen arranged the Barkindji group into three historical divisions. He included the Barindji in the East Darling division.⁶ The problematic relations between Mitchell's party and a group of Barindji in 1835 and 1836 probably led to the confrontation in May 1836 in which his men killed a number of Barkindji people.⁷

³ Cameron, 'Notes on some tribes of New South Wales', 346.
⁴ Cameron, 'Notes on some tribes of New South Wales', 347.
⁵ For example, Mitchell, Three Expeditions, 1839; vol 1, 253, 262, 321; vol 2, 71, 113, 149.
⁷ For example, Mitchell, Three Expeditions, vol 1, 264-75, vol 2, 101-4. See also Allen, 'Where the crow flies backwards'.
Allen also compared dietary habits and technology across the Murray-Darling region from 20,000 years ago to the present, as evidenced by the archaeological record and by nineteenth-century ethnographic accounts. He documented many other apparent continuities through time, though he was also able to show evidence of cultural change, in technological and dietary adaptations to the shifting ecologies of the terminal Pleistocene to Holocene. These included a diminished reliance on freshwater harvests and increasing use of seed and grain, as demonstrated by the appearance of grinding stones around 15,000 years ago.

The Lake Mungo archaeological assemblage includes a silcrete quarry on the western side of the lake, used to make many of the tools commonly found on the lunette and lake floor. The silcrete is also exposed along the shores of Lakes Chibnalwood and Leaghur, and is associated at both sites with tool-making debris, including stone cores weighing up to a kilogram.\textsuperscript{8} Tools made from the silcrete are also found across the other lakes. Red ochre, which is not found within one hundred kilometres of the lakes, coated the corpse of Mungo 3 and now stains the bones. It must have been carried to the area or traded, and suggests that the Willandra people of 45,000 years ago regarded death rituals seriously, hoarding the pigment, but not stinting on the dead.

The shores of Lake Mungo were rich in resources before the last glacial maximum. Marsupials provided protein, skins, and bones to make fish spears or needles. From the lakes people gathered waterbirds, Murray cod, golden perch, crayfish, the freshwater mussel \textit{velesunio ambiguus}, and fibre from reeds for nets or ties. They found a ready source of stone at the silcrete quarry. Dunefields and grassland beyond the lake perhaps provided seed and grain. The lunette was probably lightly wooded, useful for shade and shelter, sap and tool-making. John Mulvaney and Johan Kamminga envisaged ‘well-fed, healthy people who had a varied high-protein diet, probably provided by a wide range of food resources’.\textsuperscript{9} They noted that historically, Aboriginal people of the Murray-Darling system collected freshwater shellfish in summertime. Analogy with nineteenth and twentieth-century Murray River people suggests that emu eggshells might have been collected in late winter to spring, indicating trans-seasonal use of the lake area. Most of the marsupials represented by skeletal remains in middens, hearths and earth ovens, with the exception of the Thylacine, were common in the region a century ago. Many prefer a woodland fringe habitat, but other species indicate

\textsuperscript{8} John Mulvaney and Johan Kamminga, \textit{Prehistory of Australia} (Sydney: Allen & Unwin, 1999), 199.
\textsuperscript{9} Mulvaney and Kamminga, \textit{Prehistory of Australia}, 197.
LAND AND PEOPLE

PART FOUR – LAKE MUNGO, HUMAN ANTIQUITY AND THE WATERED INLAND

more arid ecologies, suggesting a broad subsistence base and wide foraging and hunting by the people.10

Archaeology is an inexact art. Mulvaney and Kamminga cautioned that reconstructions 'telescope data across thousands of years into one day' (see Plate 39 for example).11 Such is the nature of the evidence that it is impossible to resolve whether the lakes were used continuously by one group of people or sporadically by different groups, whether occupation was cyclical, permanent, seasonal or an opportunistic mix. It is also difficult to determine if the shell lenses, midden remains and hearths represent single feasts or gradual accumulations. The stone technology of the lakes region, famously designated the Australian core tool and scraper tradition by Allen and Jones in the early 1970s, reveals very little about population density, inventiveness, or indeed the variety of less durable material culture that might have been utilised.12

A number of workers, including Allen himself, has cautioned that direct ethnographic analogy from living or historical Aboriginal people to the fossil record, and vice versa, is not particularly useful. Colonial ideology, and the fact of European invasion itself, influenced the way Aboriginal people have been portrayed, and have portrayed themselves. The archaeologist Sarah Colley recently pointed out that 'Given the profound impact' of European explorers and colonial settlement on Indigenous societies, 'historical descriptions of Indigenous life may not accurately reflect what life was like' before British invasion. Records of 'every aspect of every Indigenous culture from every part of Australia at the time of European contact' simply do not exist. Consequently, workers have tended to 'extrapolate people's behaviour prior to AD 1788 in many different parts of Australia from information about better documented Indigenous societies in the north, west and inland regions'.13 Furthermore, prehistoric material culture is opaque. Particular objects might have had very specific, culturally and climatically determined uses which to a modern interpreter may appear counterintuitive. General questions about Aboriginal demography in the late nineteenth century, stemming in part from the abundance of discarded stone objects in the desert,

were put into perspective by J W Gregory in 1906, who reflected wryly in *The Dead Heart* that 'The fact is probably due to the stone-using people having had no pockets'.

*A site un-named is a site unknown*: Exploration and pastoralism in the Willandra Lakes region

The story of European exploration and pastoralism in the Willandra Lakes region belies Jim Bowler's claim that 'a site un-named is a site unknown'. While the Barindji doubtless had names for specific landforms and for the area as a whole, to the first European settlers, the Lake Mungo basin was simply a part of Mungo Station, established in 1864. The fact that some of its features did not enter Anglo-Australian scientific consciousness until more than a century later, when Bowler named the lakes after the pastoral leases in which they are incorporated, did not prevent them from becoming objects of contemplation and speculation earlier.

For example, Thomas Mitchell never went inland from the rivers as far as the Willandra Lakes, but had he done so, he would almost certainly have recognised them as dry lake basins, based on his experiences nearer to the Murray River and in northwestern Victoria. In June 1836, his party 'passed along a low sandy ridge, every way resembling a beach, but covered with pines and scrub. A bare grassy hill extended southward from each end of it'. The 'interesting hollow' to the west contained some water, and was 'evidently the bed of a lake, nearly dry'. Mitchell 'was struck with the analogy, and in [sic] these ridges being always on the eastern shore of hollows or lakes' while 'the western was irregularly indented, and was in some parts so abrupt as to have the character of cliffs'. He observed other basins, frequently waterless or saline, with similar features: 'nearly all circular or oval' with 'a very regularly curved ridge', now called a lunette. Further, he noted 'native ash-hills', ovens or middens on the sand ridge, which at least proved 'that this lake had once contained muscles [sic]', suggesting fresh water in the past. He had observed fish and mussels 'cooked in such ovens as these' elsewhere on the Murray. Although fascinated with, and conscious of the utility of, local Aboriginal names for places and landmarks, he rarely asked the names of these basins, nor did he name most of them himself, though he recognised their lacustrine

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nature.

Charles Sturt, closely followed by Mitchell, was the first Englishman systematically to explore the central and southern reaches of the Murray-Darling basin. Both saw in the landscape signs of former wetness, signifying on the one hand greater fertility in the past and on the other, an inland sea. Such ideas resonate with modern secular geological models of the vanished world of the Pleistocene. Although it is commonly asserted that Charles Sturt introduced cattle to the region in 1828, it is probably more precise to suggest that he lost cattle in the region in 1828.18 Thomas Mitchell's experience of Darling River people who, to his mind, must 'never' have seen cattle, but who evinced no surprise at their appearance, indicates that in any case they could have been present for some seven years since Sturt.19 The first European to survey near the lakes region was probably Granville Stapylton, Mitchell's ill-fated and erratic second-in-command on the Australia Felix expedition, who examined country west of the Lachlan in May of 1836.20 In 1860 Burke and Wills rested at Arumpo Station on their way to death and immortality – which was one of Bowler's 'two names on the map' in 1969, the Walls of China being the other.21

The history of the region is a history of the inextricability of deep from shallow time in modern Australia. In 1869 the still-extant wool shed at Mungo Station was built by Chinese labourers. Several commentators have suggested that the Walls of China, a distinctively eroded part of the lunette on the northeast shore of Lake Mungo, was named by or for these labourers.22 By 1877 Gol Gol Station covered more than 200,000 ha. Oral and written reports by local graziers and government land inspectors suggest that, like Mitchell, pastoralists and surveyors recognised the large saltbush and grass plains within the region as dry lakes, formerly filled by the Willandra Creek. In 1998, Harvey Johnston and Peter Clark identified land inspection reports made on Gol Gol Station from 1875 to 1900 which refer to areas of open plain and adjacent dune ridges as being former lake beds, and a series of 'hills' – the 'Gal Gal Hills' – which may

18 For example, Bowler, Lake Mungo: Window to Australia's Past; Sandy Guy, 'Mungo jumbo', Sunday Age 'Future Lifestyles' supplement, 8 June 2003, 6. See also Sturt, Two Expeditions, for accounts of abandoning or losing cattle.
21 Bowler, Lake Mungo: Window to Australia's Past.
22 Bowler, Lake Mungo: Window to Australia's Past; Sandy Guy, 'Dry as a bone', Qantas in-flight magazine, November 2003, 150.
correspond to the Walls of China. Thomas Mitchell's 1838 text does not mention, but his map depicts, the 'Gol Gol Ranges' in south-western New South Wales, which lie approximately in line with the position of the lakes, and may represent these Gal Gal Hills, although he oriented them incorrectly for the Willandra lunettes (Plate 40).

Ongoing large-scale erosion and sweeping dust storms in the twentieth century resulted from the combined efforts of rabbit plagues, a succession of droughts from the 1890s onward and overstocking by desperate or inexperienced sheep farmers. This rapid denudation, exposing Pleistocene stratigraphy, perhaps aided the eventual discovery of the human burials. In 1921 the highly degraded station was subdivided into 16,000 ha holdings for soldier settlers. These subdivisions included Zanci, Mungo, Leaghur and Joulni Stations. The Cameron brothers ran Mungo as a pastoral station from 1922 until 1934 when Alex and Albert Barnes, brothers who operated Joulni Station, acquired it. Although appreciative of the revelation of an ocean beneath their feet when Jim Bowler explained his theory to them in the 1960s, the Barneses expressed no awareness that they lived on the floor of a fossil lake. However their contemporary, Cliff Smith of nearby Chibnalwood Station, greeted Bowler's enquiries about unlikely shell middens and fish bones with enthusiastic recognition, 'having read the scripture of the landscape' himself.

Once again in the 1940s, pastoralists fell victim to those unpredictable and seemingly capricious climatic cycles, as rain dried up on Australia's eastern seaboard and wind blew the topsoil of the interior to the coast and across the Tasman to New Zealand in great clouds of dust. The drought was considered the 'worst in Australia's history', until similar claims for the El Niño event of 2002-3. In 1944 the artist Russell Drysdale and a journalist, Keith Newman, were commissioned by the Sydney Morning Herald to record the effects of this drought in western New South Wales, following the lifting of wartime censorship. The two, accompanied by a driver and J M Leonard, a photographer, drove several thousand kilometres through the interior of the state in November and December. Newman's articles appeared in the paper on 16, 18 and 19 December accompanied by Drysdale's line illustrations and Leonard's photographs. A further article by Newman, with photos by Leonard, appeared on 20 December.

Artistically and personally, the experience was tremendously important for

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24 See Mitchell, Three Expeditions, vol 1, map.
Drysdale. His biographer Lou Klepac wrote of Drysdale's experience of the Walls of China that 'Sitting beside the fire on a brilliant moonlit night, he found it one of the most extraordinary places in the world'. Furthermore, his drawings of eroded country, dead trees, stoic pastoralists, ruined houses and windmills, and bones, 'were seen at breakfast tables in households throughout the country'. Perhaps even more importantly, he produced a series of paintings from the sketches and photographs, including 'Walls of China, Gol Gol' (Plate 41). He brought the devastated interior home to the cities, and in the process his 'unique vision' had a transformative effect on the places and people. 'Commonly thought inappropriate and ugly', he depicted them as tragic, their ruined stoicism providing a sort of horrible majesty – 'scenes of some grandeur' in 'a most moving poem of destruction'.

Tim Bonyhady has pointed out that the canonical archaeological foundation story of the lakes – geomorphologist on motorcycle finds human burial while looking for something else, archaeologists identify and collect it in a suitcase, saving it from washing away in the next unexpected downpour – somewhat overstates the role of serendipity. Both Newman and Drysdale conceived and represented the landscape as an ancient Aboriginal one a quarter of a century before Bowler's motorbike confirmed it for the academy. Newman wrote of the Walls of China that:

The local people say that the locality is rich in Aboriginal relics. Burial grounds and weapons, and perhaps, bone fragments of the things the ancient people ate, are there to be found – and may be they could say whether one tribe flourished here for aeons of time, or whether spells of aridity drove them away until better seasons restored the water and the game.

As Bonyhady suggested, anyone who read Newman's article could reasonably surmise that the Walls of China was as good a place as any in western New South Wales to find Aboriginal bones and artefacts. Furthermore, 'Any of Newman's readers would also have understood that to delay such digging was hazardous, since bones there one day

29 Keith Newman, 'Riddle of the sands: Erosion solution may be buried there', *Sydney Morning Herald*, 19 December 1944, 5.
might be gone the next'. However, Bonyhady has overlooked the fact that Bowler came to the lakes not in search of human antiquity, but to understand climatic cycles of the last hundred millennia. The same conditions which make the preservation and discovery of human remains probable facilitated his geomorphological work. For Jim, at least initially, the evidence of Pleistocene humanity in the landscape was simply another indicator of ecological change.

Newman also understood that the 'flat grey depression' beneath the Walls was a dry lake, and gave a rudimentary account of lunette formation: 'this sandheap, unlike others, could not have been caused entirely by wind erosion. Some say the sand was on the lakebed and merely blew into this great heap when the water went. If that is so, the river that fed this lake must have been a mighty fellow … He must have chewed up a province to spit out this gritty residue'. Clearly, current geomorphological orthodoxy regarding the lakes and the formation of their leeward dunes is not new, though Newman's account could do with some refining. On 20 December, his understanding of the building of the Walls of China lunette was a little more scientifically shaky. He suggested the dune was an artefact of post-settlement erosion rather than evidence of the larger climatic cycles of which he was well aware: 'as this [vegetation] was thinned by axemen, drought, and stock, the winds concentrated on the remainder'. Sandy Guy, writing about Lake Mungo for both the Age and for the Qantas in-flight magazine in 2003, similarly misunderstood lunette formation, assuming that they erode out of sand dunes surrounding the lake, rather than build from sand and clay blowing from the lake floor: 'Centuries of wind and rain have eroded the ancient sand dunes surrounding the lake, producing hardened, crescent-shaped walls of sand and clay known as lunettes'.

In 1997, recalling Newman's vision of erosion at the Walls of China lunette as an artefact of livestock, and in a twist on the nineteenth-century notion of cultivation rejuvenating marginal country, science writer Mary E White cited Lake Mungo as an example of a degraded landscape, ruined by pastoralism (Plate 42). She attributed the mobility of the landscape to overstocking, which threatens its aesthetic and scientific value. However it is in this badlands erosion that geologists read cycles of climate

30 Tim Bonyhady, 'Disturbing the dead', Art Monthly Australia, November 1997, 12.
31 Newman, 'Riddle of the sands', 5.
33 Guy, 'Dry as a bone', 147.
34 Mary E White, Listen … Our Land is Crying: Australia's Environment: Problems and Solutions (Sydney: Kangaroo Press, 1997), 91.
change and discover archaeological material (Plate 43). In a landscape with as little natural exposure as western New South Wales, geological researchers rely to some extent on human intervention. More recent scientific accounts of the Willandra Lakes landscapes suggest that even these erosional patterns – which facilitated geological understanding – are evidence of older climatic cycles at work. Sheep, goats and rabbits have undermined the stability of the lunettes, but in a repeat of patterns found deeper in the stratigraphic record. The modern Mungo lunette was not superimposed over a smooth underlying topography (Plate 44).  

35 Newman, in contrast to White, read a message of hope in the signs of a former world: 'Does this mean that some time after the lake had died, another great cycle of rains packed down the sand and germinated plants, and that Nature with infinite patience had time to enrich the soil again before the droughts returned?'

Is any level of pastoralism acceptable in a World Heritage area? If not, then what happens to people who have farmed the area all their lives, whose families might have farmed particular landscapes for 150 years? They too developed affinity with land they understood as theirs. With particular regard to the establishment of Lake Mungo National Park, Jim Bowler recently acknowledged the Barnes families, pastoralists on the former Mungo and Joulni Stations who 'endured the climatic and economic vicissitudes of life in the Western Division of NSW, lives frequently compounded by the complexities that followed on the heels of scientific discoveries and subsequent heritage complications'. He insisted that 'the nation in general' owes 'a profound debt' to the Barneses who 'forfeited their heritage, Mungo Station, to permit the investment of that region's scientific treasures in the national interest'.  

37 The deep past and geological heritage thus redeem human failing in the recent past.

Fossil landscapes

The allure of the ancient human presence in the Willandra Lakes region often blinds us to the wonderful record of Cainozoic climate change across southeastern Australia represented by its landforms. The lakes received their World Heritage listing because they are 'now recognised as Australia's richest site for the study of human evolution and
prehistoric', but they are also recognised as a site of global *natural* heritage.  

The landscapes encountered by Barindji, pastoralist, explorer and scientist were carved, and continue to be shaped, by climatic fluctuations over millennia. The predecessors of the Barindji lived through some of these changes and left relics for those who came after to squabble over. The stories of the Barindji are lost, but traditions from elsewhere in the Murray-Darling basin offer possible analogies for the ways that the Mungo people might have understood the land. The experiences and observations of pastoralists suggest that often they were too concerned with survival to notice the lake beneath their feet, but there were exceptions, such as Cliff Smith. The reports of nineteenth-century surveyors and explorers, and the observations of Russell Drysdale and Keith Newman in 1944, show that the later discoveries and speculations of geomorphologists, archaeologists and palaeoclimatologists are not simply a product of late twentieth-century scientific savvy.  

Geomorphological and archaeological orthodoxy is often a rehearsal or refinement or secularisation of non-secular scientific ways of understanding country, a recurrent theme and key argument of this thesis.  

The modern Murray-Darling Basin is a flat-lying depression that hugs the eastern margin of the Great Divide, spans central and western NSW, through Victoria and eastern South Australia to the sea. It encompasses about 1,036,000 km², which is more than one seventh of the continent in area (Plate 37). Apart from minor leakage and discharge via the Murray River to the sea, the basin is a closed groundwater system. Groundwater at the margins of the basin is less saline than that at the centre. The basin demonstrates a significant climatic gradient. Precipitation dominates to the east. Evaporative processes are more significant in the west. Prevailing winds are westerly. Surface water flows from the east. Seasonal contrast produces hot dry summers and cooler winters with rare frosts. Let us now pick up our secular-scientific diorama at Panel 6, during the mid to late Miocene.

38 Quote is from O'Neill, 'Mungo woman returns to her people', 1. For comments on its listing as a site of globally-significant natural heritage, see, for example, World Conservation Monitoring Centre website, 'Descriptions of Natural World Heritage properties'. Online http://www.wcmc.org.uk:80/protected_areas/data/wh/willandr.html.

39 Bonyhady, 'Disturbing the dead', 10-12.


Panel 6

Tertiary and later sedimentation across the basin suggests eustatic sea-level changes during the last twenty million years. Non-marine sediments predominate in the north and the east, while sedimentary successions in the south and west extensively overlie marine deposits. Marine deposition persisted in the south of the basin until the upper Miocene-Pliocene, when the Tertiary sea retreated to the south west, depositing the water-saturated Loxton-Parilla sandsheet. This sandsheet underlies much of the Mallee region. Accordingly, it has significantly influenced ensuing Quaternary deposition. The sea covered the future site of Lake Mungo, but probably did not reach as far north as Lake Mulurulu.43 A series of sub-parallel, relict strand-lines of the Loxton-Parilla sands indicating former shorelines are preserved as north-south oriented ridges in the south and west of the basin and provided a structural constraint on drainage and lake distribution (Plate 45).44

The characteristic moon-shaped leeward dunes – lunettes – on the west of the Willandra Lakes probably formed on these ridges, except the Mulurulu lunette, whose core is a gypcrete ridge, possibly formed in an ancient hypersaline lagoon (Plate 46).45 Miocene-age events are separated from Pleistocene successions by a depositional hiatus that Jim Bowler has correlated with a deep-weathering period, as Australia drifted further north and dried. This might have closed at about 2,500,000 years before present, in the mid- to late-Pliocene.46

Early tectonic damming of the proto-Murray River led to the widespread early Pleistocene development of lake systems across much of southwest New South Wales and northern Victoria. The Blanchtown Clay and Bungunnia Limestone lacustrine (lake) deposits provide one of few absolute temperature-time correlated controls for the region.47 These grade laterally into the eastern, unconsolidated silt and clay of the Shepparton Formation, which produced the low-relief Riverine Plain of today.48

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lac-aeolian facies in the west of the basin characterise the modern semi-arid Mallee region.

**Panel 7**

In contrast to modern eastern Australian climates, the Tertiary Period was marked by relatively stable, humid climates, little or no Antarctic ice cap and higher sea levels than today. Although the Australian craton was further south, the climate was conspicuously warmer at equivalent latitudes.\(^{49}\) During the Quaternary Period, fluctuating humid and arid conditions were accompanied by profound hydrologic changes. These changes have left many of the distinctive landforms of the Murray basin as an encyclopaedia for palaeoclimatologists.\(^{50}\)

In a canonical article published in 1976, Jim Bowler observed that it is futile to speculate on past aridity without identifying possible constraints on a swing to drier conditions.\(^{51}\) The major controlling parameters he considered were increased evaporation and decreased precipitation. Increases in evaporation are usually associated with increased temperatures. This appears at odds with observed Pleistocene glacial trends. However increased wind strength can also effect an increase in evaporation, and an altered aeolian regime would not be unexpected in a glacial period. Therefore it is necessary to isolate alterations in precipitation, temperature and wind regimes.

Bowler distinguished four entwined lines of primary evidence:\(^{52}\)

- **biological:** vegetation, human habitation and faunal assemblages suggest increased aridity;
- **hydrological:** fluctuations of lake levels in the late Tertiary and Quaternary are inextricably linked to controlling climate. This is reflected in lake and river stratigraphy. Abandoned or reduced rivers reflect changes in hydrologic evolution, as observed in the region during the previous century by Charles Sturt, Thomas Mitchell, and recorded later in South Australia by Ralph Tate and others. However fluvial data are more difficult to constrain and therefore are subject to more

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\(^{49}\) J M Bowler, 'Aridity in Australia: Age, origins and expression in aeolian landforms and sediments', *Earth Science Reviews* 12, 1976, 282-3; Bowler, 'Aridity in the late Tertiary and Quaternary', 36: ‘the relatively slow movement of continental plates was subordinate to major changes in global circulation and … Australia was overtaken from the south by intensified sub-tropical high pressure belts migrating equatorwards’. See also pp38-9.

\(^{50}\) J M Bowler and Rhys Jones, 'Australia was a land of lakes', *The Geographical Magazine* July 1979, 679-85; Bowler, 'Quaternary landform evolution', 117-47.

\(^{51}\) Bowler, 'Aridity in Australia!', 284.

\(^{52}\) Bowler, 'Aridity in Australia', 286-7.
ambivalent interpretations than the evidence from lakes.

- aeolian sediments and landforms such as dunes and dust mantles: their increase during the terminal Pleistocene again points to increased aridity accompanying glacial conditions.

- soil data and stratigraphy: soil formation and preservation alternates with fluvial and aeolian deposition and the deep regolith profile of the Mallee-Riverine Plain preserves buried soil successions. Such preservation of pedogenesis is therefore a surrogate for altered wind-water regimes.

Data obtained from stratigraphic and geomorphological studies in the Murray basin suggest that large lakes and rivers were active prior to 50,000 years ago, before the last glacial maximum. As water levels started to fall, lake drying led to deflation of clay from lake floors and the consequent development of lunettes, which then evolved red soils. Increased precipitation versus evaporation between about 50,000 and 25,000 years ago induced water table rises and a subsequent freshwater, lake-full period before about 35,000 years ago. Stratigraphic evidence for this includes sandy beaches and foredunes on the eastern shores of the lakes, and the striking evidence for human occupation, in the form of middens, hearths, tools, a silcrete quarry at Lake Mungo, and human burials with sophisticated funerary rites. Streams exhibited larger channels, meander wavelengths and widths, with an estimated three to six times the volume of present streams. From about 25,000 years ago, the development of sandy point bars and source-bordering sand dunes along river channels attests to the sparseness of vegetation, which would have otherwise stabilised the landscape to some extent.53

The last glacial maximum, characterised in inland Australia by aridity and low lake levels, began about 25,000 years ago. Small glaciers formed in parts of Tasmania and possibly the top of the Kosciuszko Plateau, which experienced periglacial conditions. Otherwise, Australia remained free of permanent ice. Less precipitation in the form of snow in the high country reduced spring run-off to rivers and lakes in the eastern inland, exacerbating the effects of the drying. Periods of peak aridity and increased salinity fell between 18-16,000 years ago, exacerbated by strong westerly winds and sparse vegetation, but showing local variation. These conditions can be deduced from the contemporaneous occurrence of variably gypseous clay lunettes around depressions or on the eastern sides of lakes. Subsequent grey soil pedogenesis,

deposition of parna on the Riverine Plain and remobilisation of red, calcareous mallee dunes suggest strong wind regimes and a cessation of extensive fluvial deposition.54 People of the region might have dissolved into smaller groups, or been driven up-basin, first to Lake Mulurulu, which contained water longer than the southern lakes, and then to the rivers and coasts.

Panel 8
Following the initiation and development of modern rivers, the lakes remained saline. Evidence from the Willandra Lakes and Lakes Tyrrell and Keilambete in western Victoria suggests water levels began to rise again from about 12,000 years ago, and reached their maxima between 7-5000 years ago, before a slight decline throughout the rest of the Holocene, but regional variation can be distinguished.55 People probably returned seasonally to the lakes region, exploiting the grain crops, birds and mammals of the semi-arid zone, rather than the previously abundant freshwater harvests. Eucalypts stabilised river banks, flood plains, dunes and lunettes. Lake basins generally remain dry except where the water table has been raised by irrigation.56

It is such 'natural heritage criteria', and the ramifications for human occupation that they suggest, as well as the presence of humanity itself, that led to the lakes' World Heritage nomination as 'a fine example of a regional semi-arid environment, unmodified by the processes of glaciation or eustatic sea-level changes'. As the area has been tectonically stable for some time, 'landforms and sediments recording events of the Pleistocene epoch survive in a remarkable way', and the region has 'global significance in the study of palaeoclimatic processes'.57

While this chapter has been about the interpretation and uses of landscape in the Willandra Lakes, Chapter Fourteen, 'Fossils and people', looks first at antiquity and nationalism in the context of landscapes. It then begins to address debates about humanity in the nineteenth century, particularly as they relate to the age and origins of the Tasmanian and Australian Aboriginal people. The disposition of the material

54 J G Douglas and J A Ferguson, eds, Geology of Victoria, Geological Society of Australia Special Publication 5.
56 Bowler et al, 'Late Quaternary climates'; Bowler and Jones, 'Australia was a land of lakes', 679-85; J M Bowler, 'The last 500,000 years', in The Murray, eds N Mackay and D Eastburn (Canberra: Murray-Darling Basin Commission, 1990), 108.
remains of the human past is politically charged and not uncomplicated ethically. These earlier controversies serve to illuminate some of the sensitivities that are exposed when human antiquity and public science intersect. They also tie Part Four into the larger context of a history of ideas about signs of age in the landscape.
Chapter XIV

Fossils and people – The 'scripture of the landscape'

It is easy to forget that the antiquity of people on earth had to be discovered.¹

The title of the following section is a distillation of the main themes of this chapter. Fossil landscapes and people in the lakes – the salt lakes and skeletons of the title below – are vehicles for representation. These repositories of ideas about antiquity are also vessels for the articulation and development of national identity. 'Sandy moons' – lunettes – are part of the scripture of the land, both a turn of phrase which demonstrates the transformative function of language on landscape, and a means by which change over time can be 'read'. This section itself is a meditation on the incorporation of the Willandra Lakes into the corpus of nationally significant landscapes for its so-called natural virtues and limitations. The rest of the chapter concentrates on human antiquity and its part in the 'nationing' of Lake Mungo and its associated material remains.

Salt lakes, skeletons and sandy moons: A meditation on landscape, antiquity and nationalism

During the 1880s surveyors' reports in western New South Wales noted the presence of collections of bivalve shells and fish bones around the rims and on the surfaces of broad dry ovoid saltbush plains.² As early as 1838 Major Thomas Mitchell identified these plains and their leeward arcuate dunes as dry lakes, by analogy with existing salt lakes:

The hills on the margins of the Australian salt lakes are always on the north-east side, or opposite to that of the prevailing south-west winds. The formation of these hills is probably due to the action of the wind … while in some cases, where grassy flats had once been lakes, crescent-shaped green mounds were still apparent on the north-eastern sides of each.³

The scientific salvation of the Willandra Lakes Region lies in the more recent past. It was not until the 1940s that geomorphologists described the formation of these 'crescent-shaped green mounds', or 'lunettes', as being driven by cycles of aridity and

² Johnston and Clark, 'Willandra Lakes archaeological investigations', 105.
³ Mitchell, Three Expeditions, vol 1, 373. (See p 268 for description of lakes).
humidity and prevailing winds during the last ice age. Lunettes are transverse, stable dunes which form upwind of lakes. They are ubiquitous in semi-arid southern Australia on the eastern shores of lake basins. They have also been reported in arid inland Australia where they may be critical elements in the genesis of longitudinal sand dunes. A number of models has been generated to explain their existence and development. The discovery of the diagnostic importance of ephemeral and dry lakes has allowed their reconfiguration as things of beauty. Jim Bowler, writing about Australian salt lakes in 1981, suggested that they are 'as rich in scientific potential as in the beauty they often display … even the dry and apparently desolate salt encrusted "lakes" (salinas) of inland Australia possess their own harsh but enticing appeal'.

Among the lunettes of the Willandra Lakes, Bowler and colleagues from the Australian National University differentiated three main dune building stages. A quartz sand foredune phase corresponds to lake-full, freshwater regimes and relatively humid conditions. A change to more arid, saline conditions and lower lake levels, when the watertable intersects with the surface, is represented by pelletal clay and gypsum, or copi, dune phases. Finally, pedogenesis (soil formation) occurs. Such soil disconformities provide evidence of an abeyance in active dune formation and deposition. They often separate major dune-building units. This well-documented sequence enables effective palaeo-climatic and hydrologic reconstructions (Plates 47 and 48).

Lunettes are bow-shaped in plan with fixed arms that point upwind, clinging to the shoreline. The crest of a lunette is closest to the lake edge, as the windward side of the dune is the steeper of the two (Plate 47). The size of a lunette is directly proportional to the size of the lake that it borders. Australian lunettes vary in topographic expression and composition, from silt and clay to gypsum to sand to a combination of these, and regularly exhibit cross-bedding or gravel. The Lake Garnpung lunette, north of Lake Mungo, is the biggest clay lunette in the world (Plate 49). Dry lake lunettes are generally inactive, but the lunette at saline Lake Tyrrell in western Victoria is active.

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7 Bowler et al, 'Late Quaternary climates', 379-80.
and may be a useful analogy for the formation of clay-phase dunes in the Willandra Lakes.

The Western Division of New South Wales has always been marginal pastoral country at best. We now recognise that patterns of severe drought characterise the region. But perhaps the acceptance of limitation is contingent not so much on the pronouncements of climatologists and agricultural scientists, as on those constraints being brought home – literally – in the dust storms that hit the eastern sea-board sporadically when the western interior has been razed by drought, as in February 1983 and December 2002, and in gruesome photographs of dying and dead stock in the popular media. In the drought of the mid-1940s, this realisation of the limits of country was also dawning. Keith Newman observed that 'Nature's purpose was to hold the desert in check, not to provide food for imported animals recklessly multiplied'. The Sydney Morning Herald commissioned the distinguished geographer Griffith Taylor, by then based in Canada, but formerly at the University of Sydney, to write a series of articles in 1944. His first was about Australian deserts, illustrated with a drawing by Russell Drysdale, of erosion south-east of Broken Hill. Taylor noted with irony, and not without bitterness, that his books had previously been banned in Western Australian schools for his views: 'There was universal objection to using the term "desert" for any part of the Australian interior. I imagine that Australians now realise that a desert by any other name is just as dry'.

This new-found ecological sensitivity that Taylor looked for foundered after better seasons and the widespread deployment of irrigation restored the interior, only to flicker back to life when the limited carrying capacity of the land was once again tested in drought. In a report to the World Heritage Plan of Management Committee in the mid-1990s Jim Bowler and John Magee declared that deeper understanding of the long histories of the landforms might teach that 'delicate balance, so necessary in establishing management practices' in the region. They noted wryly that one of 'the few reliable predictors of climate' in the region 'is the certainty that a run of good years will be followed eventually' by drought.

Russell Drysdale's painting 'Walls of China' is a canonical evocation of drought

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8 Keith Newman, 'An artist's journey into Australia's "lost world"', Sydney Morning Herald, 16 December 1944, 5.
in Australia's arid interior (Plate 41). Painted during 1945, based on sketches the artist made during the journey with Newman, it was bought for £200 by the Art Gallery of New South Wales in late 1945 by the new Director, Hal Missingham. Missingham shocked the trustees with his expensive, eccentric purchase. They in turn 'reacted by immediately cancelling my powers, some claiming that tourists would be outraged at this stark portrayal of our land'.\(^{11}\) The painting depicts the eroded Mungo dune as a series of low, carved, red hills, the backdrop to an arid plain with a tortured, skeletal tree trunk, and a red, dusty sky above. Drysdale named the painting 'Walls of China, Gol Gol', although by 1945, the gigantic pastoral station had been sub-divided, and the Walls spread across the smaller Mungo and Joulni Stations.

The reaction of the trustees suggests Lake Mungo's public beginning as a national landscape, before it had a name, as a 'stark', desolate land of skeletons. Missingham's gamble paid off. The painting was exhibited overseas and was for many years 'one of the few Australian pictures one could buy as a colour reproduction'.\(^{12}\) It thus fed an idea of a landscape of ghosts and skeletons that was hostile, broken and desolate, but could also be integrated into a national psyche which located pride in the hardiness of the men and women who survived life on the 'long tragedy-track over scorchèd earth', as Newman described the blighted region on his journey with Drysdale. He noted of the country between the Darling and the Lachlan Rivers that 'however far from the great cities', and notwithstanding its desolation, 'this land was part of our heritage and our future'.\(^{13}\) Otherwise, as Tim Bonyhady suggested in 1997, the Walls 'remained almost unknown', and the ovoid saltbush plain at their base 'had not even been named and was not always recognised as an old lake-bed'.

Still characterised as poor grazing country, badly watered, semiarid, fringe, unforgiving, degraded, the lakes landscapes nonetheless began to be redeemed by the 'unparalleled record' of Quaternary climate change revealed in their sediments. Still they remained marginal landscapes. Then Jim Bowler's discovery of human remains in 1968, coming as it did at a time when some Australian archaeologists had begun to insist on a Pleistocene antiquity for Aboriginal Australians, catapulted Lake Mungo and the rest of the lakes into the global archaeological canon. The cultural significance attached to the human remains attracted World Heritage classification. Without the concomitant

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\(^{12}\) Bonyhady, 'Disturbing the dead', 10.
\(^{13}\) Newman, 'An artist's journey', 5.
funding and publicity, the lakes could still be a geomorphologic footnote plagued by goats and emus. As a World Heritage Area, it offers instead global standing, national significance, shared heritage and an incomparable timescale.14

In *The Custodians*, his epic meditation on Australian identity, Nicholas Jose shifted the cunningly disguised 'Lake Moorna', in true South Australian fashion, to west of the border (even in an account of national identity, parochialism with its roots in pre-Federation proto-nationalism plays a part). He evoked 'Lake Moorna' with an archaeologically informed sense of majesty, age and mystery, but one which was intrinsic to the landscape, independent of the works of humanity. Geology provided meaning, a new way of 'seeing' a landscape in the fourth dimension. Jose's geomorphologist Fritz Vogel (a sort of Teutonised Jim Bowler) 'had seen through the surface of the land with his X-ray eyes to pictures of time beneath … Here, in what was now a flat, parched, barren landscape, people could have lived a pleasant lakeside existence abundant in fish, flesh and fowl'.15 In Jose's recreation, the mystical experience was vindicated, not created by Moorna/Mungo Woman's discovery:

without breaking into features of even the simplest narrative, the country went on for miles ... The dry sunken bed of Lake Moorna … was the dominant feature only because it was even more minimal than the surrounding plain … The negation of landscape as conceived in the pictorial tradition: no alps, no crags, no ruined towers, no nestling hamlets; in that lay its teasing eloquence.16

On 2 June 1836, Mitchell surveyed east and west of the Darling, not far from its junction with the Murray at the present site of Wentworth, and saw only 'unvaried desert features'.17 Drysdale's 1945 series of paintings of the region has been described as 'amongst the most terrifying images of devastation ever painted'.18 These days, the Walls of China appears on stamps, and visitors can pay $60 per person for a day trip to the

14 J M Bowler, 'Willandra Lakes revisited: Environmental framework for human occupation', *Archaeology in Oceania* 33(3) 1998, 120: 'The Willandra Lakes World Heritage area offers an opportunity to integrate physical environmental history with ancient cultural heritage, an issue of special importance to all Australians. The detailed record of this region provides one of the best examples of ancient people-land interaction on time scales rarely matched anywhere in the world'.
National Park with Harry Nanya Tours. The deep past provides a new aesthetic, according to which the sparse, worn, dry, goat-infested landscape is reconfigured as an 'eerie, yet beautiful, moonscape', 'a constant source of mystery and delight', spectacular, surreal and dramatic. Tourist destination, World Heritage region, geomorphological text book, archaeological wonderland, National Park, Aboriginal sacred site, contested country: the lakes landscapes, especially the Walls of China lunette, are now unambiguously national landscapes.

**Nineteenth century naturalists and the antiquity of men**

Debate about the antiquity of man occurred against the background of the invention of glaciology and its incorporation into Lyell's gradualist paradigm, and speculation about extinction and fossil fauna in the landscape. Donald Grayson stated that this bespoke metaphysical landscape incorporated the signs of humanity in the form of tools and skeletons, eventually to convince mainstream naturalists that the evidence for a deep human antiquity was overwhelming.

Throughout the early years of the nineteenth century, claims for the discovery of human remains or material culture in association with extinct fauna and ancient landscapes were ardently rejected. Many commentators were disturbed by the suggestion that human beings could be contemporaneous with the faunal products of earlier and 'lower' creations. Charles Lyell, for instance, stated that 'What is at stake is the dignity of man'. Eventually discoveries on the continent, most notably by the French customs director at Abbeville, Jacques Boucher de Crèvecoeur de Perthes, in the Somme valley gravels, convinced many European commentators of the contemporaneity of mankind and extinct fauna, although they baulked at his diluvial framework. In Britain, mainstream scientific acceptance came more slowly. It was precipitated by an excavation at Brixham Cave, near Torquay, where in 1858-9 William Pengelly and Hugh Falconer discovered a clear association of flint tools with extinct fauna. Older cave evidence, previously rejected, was re-examined. Lyell's capitulation on the question of human antiquity appeared as a paper delivered to the BAAS at its

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19 Anon., 'Making tracks: Aboriginal tours at Lake Mungo', *Age* Travel supplement, 16 August 2003, 6.
20 Sandy Guy, 'Mungo jumbo', *Sunday Age* 'Future Lifestyles' supplement, 8 June 2003, 6.
1859 meeting, 'On the occurrence of works of human art in post-Pliocene deposits'.

This section deals briefly with the intellectual situation in Britain with regard to the age and origins of humankind during the mid- to late-nineteenth century. As such, a thorough history of the development of the discipline of archaeology from its antiquarian roots is largely irrelevant, and has been dealt with in some detail by a number of other authors. Central to this shift, and of critical importance to the interpretation of Aboriginal material culture in Australia, was the idea, first clearly articulated in Richard Colt Hoare's work Ancient Wiltshire (1810-1821), that artefacts were more than simply objects of value in their own right, and 'were of primary use as evidence and sources of information' about the ancient people who left them. Consequently, excavations took on greater significance, not just as a means to uncover the buried treasures of hearth and barrow, but as a way to address specific problems of antiquity.

Following from this focus on the history encoded in artefacts, the invention of the 'Three Age System' in Scandinavia in the 1830s revolutionised the practice of prehistory in the nineteenth century. It established a relative chronology which allowed systematic classification of tools by type and time, and was, for sixty years, 'the essential structure for the organisation of British prehistory'. Early in the century, a Danish historian, Vedel Simonsen, described three stages in the history of humankind, delineated by changes in material technology unearthed by antiquarians: a Stone Age, succeeded by a Brass or Bronze Age, in turn succeeded by an Iron Age. This system was adopted by Christian Jurgensen Thomsen, the curator of the National Museum of Copenhagen, who began in 1836 to rearrange his collections according to Simonsen's system. John Jacob Rasmussen Worsaae, Thomsen's pupil, expanded Simonsen's and Thomsen's ideas, unearthing further evidence of the sequence in the peat bogs of Denmark. The English translation of his treatise, The Primeaval Antiquities of Denmark, appeared in 1849, where it did not find wide acceptance at first. Commentators dismissed it as 'specious' and 'without foundation'.
Eventually a number of English antiquaries accepted the fundamental accuracy of the system, adding refinements of their own. Most effectively, John Lubbock, Lord Avebury, proposed in a series of articles in the *Natural History Review* (expanded into his book, *Prehistoric Times*, in 1865) a division of the Stone Age of Thomsen into a Palaeolithic Age 'when men shared possession of Europe with the Mammoth, the Cave Bear, the Woolly-haired Rhinoceros and other extinct animals', and a Neolithic Age, 'the later or polished Stone Age'. Lubbock's book went into five editions in its first 25 years.29 His work also retained the Bronze and Iron Ages of Simonsen, Thomsen and Worsaae. The term 'mesolithic' was introduced in 1866, making it a system of five periods or ages.30 Australia was a prehistorian's candy shop – full of stone tools and the skeletons of the people who made them. Accordingly, living Aboriginal people could be slotted into a continuum of primitiveness according to the stone tool typologies of Europe, and craniometric analyses of their dead.

**The age and origins of the Australians**

Australian archaeology is suffering the direct backlash of the dreadful history of the Aborigines in Australia since the Europeans arrived. It is a story in which 19th-century anthropology had a significant complicity. … the craniometric ranking labelled native Australians as backward things, living fossils from an Old Stone Age. It gave an intellectual underpinning to their displacement by Europeans, if not to their physical extermination.31

It was against this background of an emerging science of race in Europe and Britain – which the discovery of a deep history of humankind altered profoundly – that metropolitan naturalists began to refine their speculations on the origins of the Australians and Tasmanians. But from their first encounters in the seventeenth century, British voyagers and Aboriginal people have provided each other with vehicles for representing themselves in contraindication to strangers.

There are no written records of the earliest Australian traditions regarding the white men, but for the Europeans, the people native to the southern continent slotted easily, if problematically, into reflections about civilisation, degeneration and racial society, archaeology in society', in *Prehistory to Politics*, eds Bonyhady and Griffiths, 66-8.


30 Marsden, *Pioneers of Prehistory*, 47.
type, and metropolitan debates about the origins and spread of mankind. From William Dampier's first famous encounter in 1688 to James Cook's, nearly one hundred years later, English impressions were diverse, but highly codified, loaded with signifiers of savagery. Dampier declared of the people he saw on the coast of Western Australia that:

The Hodmadods ['Hottentots' of the Cape of Good Hope], though a nasty People, yet for Wealth are Gentlemen to these … And setting aside their Humane Shape, they differ but little from Brutes … They have great Bottle Noses, pretty full Lips, and wide Mouths. The two Fore-teeth of their Upper jaw are wanting … Neither have they any Beards. They are long visaged, and of a very unpleasing Aspect, having no one graceful Feature in their Faces. Their Hair is black, short and curl'd, like that of the Negroes; and not long and lank like the common Indians. The colour of their Skins, both of their Faces and the rest of their Body, is coal black, like that of the Negroes of Guinea.32

Eleven years later, he was no kinder, having determined that 'they all of them have the most unpleasant Looks and the worst Features of any People that ever I saw, though I have seen great variety of Savages … black Skins, and Hair frizled, tall and thin'.33

In comparison, Joseph Banks wrote of people he observed on the Endeavour River in 1770 that 'certain it is that Dampier either was mistaken very much in his account or else that he saw a very different race of people from those we have seen'.34

Banks and Cook stressed constantly the un-likeness of the people of the east coast either to Dampier's account, or to 'negroes' more generally, instead reading comparisons with Pacific Islanders. As settlement proceeded, interest in the Indigenous Australians did not fade with greater familiarity. Scarcely would an inland explorer complete the public account of his expedition, than he would supplement it with a commentary on The

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Australian Native, His Origins, Nature and Future, and Reasons For His Decline.  

From before 1788, the Europeans speculated about the origins and age of the Australians. They were co-opted into a scheme of natural history which saw Australia as a land of living fossils, its people static and primitive like its flora and fauna. This attitude had ramifications for the professional development of archaeology in Australia. If Aboriginal people had no deep past, what was the point in studying it? From the time of Ranken's and Mitchell's establishment of the *longue durée* of Australian marsupials in 1830, naturalists were eager to establish or refute Aboriginal synchronicity with the age of the bone beds at the Wellington Caves. At Lancefield and at Lake Colongulac in the 1840s, claims were also made for associations of Aboriginal tools with the fossils of giant marsupials, and human remains of questionable antiquity were regularly exhumed on the Darling Downs in Queensland. The problem was one of taphonomy as much as anything else. As witnessed at Lake Mungo a century later, the deep past in Australia is often literally very shallow. Depth of artefacts or bones could not be correlated with age.

However, the inconclusive nature of the evidence for human occupation at the best-known fossil sites was no deterrent to metropolitan scientists eager to connect Australian evidence to the better-known northern hemisphere data, and untangle the chronological, possibly causal, relationships between prehistoric humanity, the glacial epoch and the extinction of the megafauna. Geologists and palaeontologists were responsible for much of this work in the nineteenth and early twentieth century, for example, Robert Etheridge Jnr, R L Jack, Gerard Krefft, J W Gregory and, most notably, A W Howitt, all combined geological work with ethnological speculation and vice versa.

The absence of stone tools in direct, indisputable association with megafaunal remains made correlation with northern hemisphere ice age cave sites more difficult.

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36 For example, see R Etheridge junior, ‘Has man a geological history in Australia?’, *Proceedings of the Linnean Society of New South Wales*, 2nd series, vol v, 1896, 259-66; A W Howitt, *The Native Tribes of South-East Australia*, 1904
Studies of Aboriginal people were considered very important to establishing world-wide racial classifications. Their origins, antiquity and affiliations could be fixed by looking at their bodies, their skulls, faces and hair, their languages, material technology and their arts, as well as their oral traditions. Before radiocarbon dating methods became established in the 1950s, it was very difficult for researchers to determine the age of artefacts and sites. Aboriginal stone tool typology is less clear-cut than the European system. The five-age system was useful only for placing modern Aboriginal and Tasmanian people in a primitive stasis. Eventually developments in phrenology and physical anthropology (themselves reliant on a trade in body parts) facilitated the assignation of racial types. A letter written in July 1847 from R C Gunn to Edmund Hobson, then resident in the Port Phillip district, highlights the nonchalance with which collectors gathered the funerary remains of Aboriginal people into museums and private collections. Gunn casually explained to Hobson that he was ‘off to Hobart Town about the day after tomorrow, but only for a few days. I shall pick you up some skulls and bones on my return Home – also fossils’.

In 1884 or 1885, the Talgai cranium, the skull of a young boy, apparently either heavily deformed or primitive, was found in a dry creek bed near Warwick in southeast Queensland by William Naish, a stockman. Despite Naish’s discovery, in 1892 Jack and Etheridge asked if man had a geological history in Queensland and answered no. In contrast, citing physiological, linguistic and artistic evidence, A W Howitt ruled in 1904 that the Australians had been here a long time: ‘the conclusions to which I have been led as to the origin of the Tasmanians and Australians necessarily demand a vast antiquity on the Australian continent for the former, and a very long period of at least prehistoric time for the latter.’ But the question was by no means closed. Naish showed Edgeworth David the Talgai site in 1914, and David spent the next decade trying to prove Aboriginal antiquity on the basis of the find. In 1925 the debate played out in

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37 For example, the renowned anthropologist E B Tylor claimed for the Tasmanians ‘a stage lower than that of the Quaternary period’ in Europe (‘On the Tasmanians as representatives of Palaeolithic man’, *Journal of the Anthropological Institute of Great Britain and Ireland* 23, 1894, 148) - ‘living representatives of the early Stone Age, left behind in industrial development even by the ancient tribes of the Somme and the Ouse’ (p149). They are the ‘lowest of normal tribes’ (p152). The Australians, on the other hand, stood on a marginally ‘higher’ level than the Tasmanians, demonstrating a greater ‘advancement’ in tool kit, sea craft etc, representing hunting tribes of the Neolithic age. He justified study of the Tasmanians as ‘a subject materially affecting the history of the Stone Age, namely, the persistence among these modern savages of a state of stone implement making comparable to that of mankind in their remotest acknowledged antiquity’ (p142).

38 R C Gunn (Van Diemen's Land) to E C Hobson (South Yarra), 3 July 1847, Box 865/2B, Edmund Charles Hobson, Papers, MS8457, LaTrobe Collection, State Library of Victoria, Melbourne.

39 Howitt, *The Native Tribes of South-East Australia*, 33.
newspapers, David decrying those commentators who judge antiquity 'by depth' rather than 'primitive characteristics'. A letter from Miss Georgina King on 25 May 1925 in the *World's News* asserted that she had heard that the Talgai cranium was a skull from the Darkey Flat Massacre, so historical, not prehistoric. E D Gill revisited the site and the issue in the 1960s. In the 1970s the skull was dated by radiocarbon to 13,000 years.

In 1929, Norman Tindale and Herbert Hale, both of the South Australian Museum, undertook the first properly documented, systematic, scientific archaeological excavation in Australia at the Devon Downs rock shelter in South Australia. In 1936, Fred McCarthy of the Australian Museum likewise conducted a systematic excavation at the Lapstone Creek rock shelter in the Blue mountains. The excavators recorded change over time in stone tool technology at both sites, laying the groundwork for future archaeological syntheses. Apart from the work of Tindale, Hale and McCarthy, archaeology received very little institutional support over the next twenty years, but was the domain of amateur collectors and antiquarians.

John Mulvaney is widely regarded as the founder of professional archaeology in Australia. Having studied archaeology at Cambridge, Mulvaney returned to the University of Melbourne and in the late 1950s taught the first course in prehistory at an Australian university. By 1964, prehistorians were employed at universities in Canberra, Sydney and Armidale as well. In 1960, Mulvaney established radiocarbon dates of 14,000 years at Kenniff Cave rock shelter in central Queensland. Then in 1968, Bowler found Mungo 1. He and his colleagues published a conservative date of 18-25,000 years in *Nature* in 1972, and the antiquity of the Australians finally took on national and international significance.

The Mungo remains took on greater importance when Alan Thorne contrasted them with the more 'robust' and 'primitive' Kow Swamp remains, found on the Murray River near Echuca in the late 1960s.

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40 T W E David, Response to D Campbell (26 February 1925), *Sydney Morning Herald*, 4 March 1925
41 E D Gill, Notebook 14, in Gill, Papers, PA884, Notebooks 1-58, La Trobe Collection, State Library of Victoria, Melbourne, 1963-4, 46-149.
different Pleistocene colonisers. The first wave was a robust descendant of the Java *Homo erectus* whose descendants are exemplified by the Kow Swamp skeletons. The later wave of more delicately constructed Lake Mungo-type people arrived in Australia direct from southern China, descended from a north Asian *Homo erectus* like Peking Man. Thorne believes that the younger Kow Swamp remains are a relic population of the older Javan type. Other workers claim that the Kow Swamp remains – which have in any case recently been re-dated to the last glacial maximum, at least 18,000 years ago – are simply the result of a community becoming isolated genetically due to the rigours of the ice age climate. Compelling evidence suggests the distinctive shape of the Kow Swamp skulls is a result of deliberate deformation by pressing on the foreheads of babies. Colin Pardoe suggested in 1995 that skeletal morphology simply reflected the extension of the Pleistocene arid zone into much of the Murray Basin. He claimed that the Willandra skeletons show a people 'typically arid-zone adapted': lean, with long limbs. Some workers even suggest that 'Mungo Man' is in fact an adolescent woman. The so-called gracile-robust debate could be partly an artefact of sexual dimorphism.

Thorne and Bowler have also recently been involved in separate re-dating of the Mungo 3 remains. In 1998, Bowler and D M Price published revised dates of 45,000 years for Mungo Man. The next year at the Australian National University, Thorne's group published a new date, revolutionary for involving direct dating of the bone, claiming to push human occupation back to 61-81,000 years. It was first announced in a seminar at the ANU on 21 May 1999 with a great deal of media fanfare, then published

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49 Pardoe, 'Riverine, biological and cultural evolution', 703.


in the *Journal of Human Evolution*. Bowler and John Magee countered with 'a sceptic's view' in the journal the next year, pointing out correctly that the bones cannot be older than the sediments in which they are buried. Another paper by geochronologists Richard Gillespie and Bert Roberts also suggested the new date was too old. In the same issue, ANU dating specialists Rainer Grün and Nigel Spooner, together with Alan Thorne, published their detailed reply, suggesting that Bowler, Magee, Gillespie and Roberts had failed to understand their data, claiming that their own dating methods, directly from the bone, are 'more' definitive, and lamenting that 'we are still not able to read the minds of our colleagues'. Bowler responded in an opinion piece in the *Australian* in 2001.

Bowler attributes the controversy surrounding the dates to intellectual demarcation disputes, rivalry, personality clashes and factionalism between and among the disparate disciplines and institutions involved in the study of human antiquity. He also takes some responsibility for any misunderstanding regarding the former shape of the Willandra Lakes landscapes. His idealised models of lunette stratigraphy in the lakes are canonical images in texts dealing with archaeology and geomorphology in the region. They necessarily depict the ancient dune profiles as smooth layers overlying each other, leading to the assumption that the characteristic yardang-style erosion and gullying in the region is an artefact of pastoralism. However, the dune stratigraphy is far from a simple layer cake (Plate 44). The failure to recognise ancient gully infill might have resulted in an artificially older date for Mungo 3.

The age of the Mungo remains has significance for questions about the extinction of the Australian megafauna, addressed in brief in Part Three. A number of models has been proposed to account for the disappearance of most animals of 100

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52 Thorne et al, 'Australia's oldest human remains', 591-612. See also Anon., Press release, 'The dating of an ancient skeleton raises questions about human evolution in Australia', embargoed to 20 May 1999, Australian National University, Canberra; Simon Grose, 'Mungo 3 time frame dates to 68,000 years', *Canberra Times*, 21 May 1999; Janine MacDonald, 'Mungo Man older than thought', *Age* (Melbourne), 21 May 1999; James Woodford, 'It's a date – our Mungo Man was here 56,000 years ago', *Sydney Morning Herald*, 21 May 1999.

53 Grose, 'Mungo 3 time frame dates to 68,000 years'; Bowler and Magee, 'Redating Australia's oldest human remains: A sceptic's view', 719-26; Gillespie and Roberts, 'On the reliability of age estimates for human remains at Lake Mungo', 727-32; Grün et al, 'Age of the Lake Mungo 3 skeleton, reply to Bowler & Magee and to Gillespie & Roberts', 733-41.

54 J Bowler, 'Mungo dates out of kilter', *Australian*, Opinion, 10 January 2000, 11.


56 Douglas, 'Land systems and stratigraphy of Lake Mulurulu'.
kilograms of more from the continent during the late Pleistocene. Whether climate change, or one of the various models requiring human intervention, each relies on establishing the earliest human habitation of the continent, as well as the timing and extent of climatic shifts, in relation to megafaunal extinction. *Procoptodon* and *Macropus Titan* remains (respectively, a gigantic, browsing, sthenurine kangaroo and a huge grazing kangaroo morphologically similar to the modern grey) have been found in the Willandra Lakes, but not in any clear association with human remains. But the dates of 45-50,000 years for the earliest human skeletons in the area fall within the most recent reliable dates for the youngest megafaunal remains.57

**The material remains of the past**

At issue are fundamental questions of ideology and ownership. Does the history of humans in Australia, which is now known to date back 30,000 years, at least, belong to the ethnic descendants of those first inhabitants? … Or is there some wider claim, of science and common human concern, to rights of access to relics of the past? Is it, perhaps, pushing an ethnic group's rights over its own past a long way to suggest the skulls of Lake Mungo, which are now upwards of 1000 generations old, 'belong' only to their assumed modern descendants.58

Why are these questions important? What is repatriation and why does it matter? Fundamentally, who cares? As the above extract from archaeologist Christopher Chippindale's 1985 article suggests, archaeologists in Australia and overseas have been forced over the last three decades to engage with newly vocal Indigenous stakeholders and newly recognised obligations other than those required by legitimate scientific enquiry. The past, its material remains and their interpretation have become contested, unstable ground. Today the repatriation debate is a major preoccupation of museum curators, professional and academic archaeologists and anthropologists. It is part of the cultural, ethical and legislative landscape of collection, curating, analysis and heritage which archaeologists cannot afford to ignore. It is itself a multiply contested, emotive


58 Chippindale, ‘Skeletons rattle down under’. 
area, which defies generalisation. So my entry into the debate is necessarily small, and limited mostly to discussion of skeletal remains in Australia, particularly those two emblematic burials, Mungo 1 and Mungo 3.59

Material remains of the past are cultural artefacts with powerful political resonance. They are part of the fabric for the construction of an illusory national unity, the glue which sticks us to the land. The rhetorical confusion of representation of the repatriation debate and archaeology in the popular media locates 'knowledge' or 'the past' — rather than the possibility of knowledge about the past — in bones and cultural material. For instance, in a popular archaeology textbook, Colin Renfrew and Paul Bahn pointed out that 'The past is big business — in tourism and in the auction rooms. The past is politically highly charged, ideologically powerful and significant. And the past, or what remains of it, is subject to increasing destruction'.60 'The past' is not a thing to be bought or sold, destroyed or salvaged. What Renfrew and Bahn intended to suggest is that its material remains are endangered. As discussed in Chapter Two, knowledge, history and power are understood to reside in objects. The Mungo remains are reconfigured as Adam and Eve, symbolising the professional beginnings of a discipline and the backward extension of a nation as much as the spiritual heart of an Indigenous population and perhaps a new beginning for academic-Aboriginal reconciliation.61

Isabel McBryde has asked whether archaeologists have 'taken possession of a past that is not ours, and either unwittingly or paternally collaborated in its appropriation as symbol of national identity?'. She suggested that we consider why Australia's nominations for cultural sites for World Heritage listing 'have all been places of outstanding Aboriginal cultural heritage'.62 She then questioned whether this

59 For more comprehensive recent discussion, see Colley, Uncovering Australia; Cressida Fforde, Jane Hubert and Paul Turnbull, eds, The Dead and their Possessions: Repatriation in Principle, Policy and Practice, (London: Routledge, 2002); Griffiths, Hunters and Collectors, 94-100; McBryde, 'Past and present indivisible?', 79-83; Mulvaney and Kamminga, Prehistory of Australia, chapter 1, especially 8-10. See also the findings of the Human Remains Working Group, established in May 2001 by Alan Howarth, then Minister for the Arts in Britain, chaired by Professor Norman Palmer: Report of the Working Group on Human Remains in Museum Collections (Palmer Report).


61 These issues of 'indigenisation' and appropriation were covered in greater detail in Part One - see my discussion in Chapter Two of Denis Byrne's important 1996 article, 'Deep nation: Australia's acquisition of an indigenous past', Aboriginal History 20, 1996, 82-107, and David Carter, 'Future pasts', in The Abundant Culture: Meaning and Significance in Everyday Australia, eds David Headon, Joy Hooton and Donald Horne (St Leonards: Allen and Unwin), 1995, 3-15.

62 This has changed with the World Heritage nomination of Melbourne's Royal Exhibition Building and Exhibition Gardens in 2002 (See 'Kemp announces important World Heritage first: The Melbourne Exhibition Building', media release, Minister for the Environment and Heritage, Dr David Kemp, 13
constitutes 'recognition? appropriation? or relegation of a dynamic culture and its creators to be seen once more as components of natural history?', in a rehearsal of nineteenth and early twentieth-century racial science orthodoxies.\(^{63}\)

Many contemporary prehistorians who are opposed to repatriation counter that their aims and methods are 'different' from the physical anthropologists and comparative anatomists of the nineteenth and early twentieth centuries. They thereby fail to appreciate the legacy of anger and disempowerment stemming from the insensitivity and rapacity in the name of racial stereotyping and essentialism from which their disciplines are fashioned. They argue their right to study human remains on the basis that knowledge about human history should be global and that each of our pasts is all of our pasts. For example, in the Kennewick Man saga, investigative journalist Jeff Benedict and forensic anthropologist Doug Owsley asserted that, when the US Army Corps of Engineers, acting in the perceived interests of Native American tribes in Washington State, seized the Columbia River skeleton from archaeologists, it was threatening 'a wide body of knowledge about our past and our history that would be lost forever if the bones were reburied'.\(^{64}\) They argue from philanthropic and humanistic principles. As Renfrew and Bahn insisted, 'the essential truth [is] that archaeology is an exciting quest – the quest for knowledge about ourselves and our human past'.\(^{65}\) Arguments are generalising and scientistic, in counterpoint to the personal, spiritual and cultural arguments of Indigenous people and their representatives.

As Rodney Dillon, the Chair of the Culture, Rights and Justice Board of ATSIC indicated in an open letter to the UK culture secretary (published recently in New Scientist), it is not a simple case of rationalistic scientists and research institutions versus anti-scientific Indigenous people and their representatives: 'Indigenous people are not backward or anti-science: we are aware of the possible benefits of research'. Dillon highlighted inconsistencies in British legislation: 'The Human Tissue Bill … has made it clear that the scientific benefits from tissue and organs taken from deceased patients do not take precedence over the rights of those people and their families'.\(^{66}\) The same applies to organ donation in Australia. Why, as Dillon asked, should the rights of

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\(^{63}\) McBryde, 'Past and present indivisible?', 74.


\(^{65}\) Renfrew and Bahn, Archaeology, 9.

Indigenous people over the remains of people they identify as their ancestors 'be sacrificed for the alleged benefit of humanity in general when others are not asked to make such a sacrifice?' Without compromise, the controversy is irreconcilable.

Elsewhere in The Custodians, 'Ralph Kincaid', a Welsh archaeologist and thinly disguised proxy for the late Rhys Jones, argued that archaeology's 'real treasure was not gold or silver, but time itself ... And the latest arrivals ... wove themselves into the story as excavators and articulators ... Australian prehistory was an essential nation-forming discipline'. The mystery and the monumentalism of the deep past evoke reverence at Mungo as at Callabonna but this is the human past. Despite the site's World Heritage classification under both natural and cultural criteria, it is for illumination of the human past that the area is chiefly and popularly celebrated, even by geomorphologists.

This is problematic. Western science requires that knowledge be shared, notwithstanding the demands of institutional brinkmanship and intellectual copyright. Consequently antique human remains, even those that have already been studied, must be stored against the possibility of new insights into human descent, demographics, diversity and disease. On the other hand Aboriginal people of Mutthi Mutthi, Paakintji and Nyiampa descent claim custodianship of the land and human remains, severely limiting the freedom of scientific research there. Such issues of the 'ownership' or 'custody' of material remains have not yet clouded non-archaeological localities such as Callabonna and Hallett Cove, except where they overlap with cultural or archaeological sites. However geological and national heritage generally are perceived by some as being under siege by a politically-driven, 'non-scientific', 'anti-scientific' or 'creationist' indigenous activism.

The American situation is clouded by the current debate about whether 'scientific creationism' should be taught at schools as a legitimate alternative to

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67 Jose, The Custodians, 354.

68 See, for example, Bowler, 'Willandra Lakes revisited', 120: 'The association here of complex burial ritual (Mungo 3) involving anointing with ochre at this time presents one of the dramatic mysteries of ancient human cultural development. In death, the story of that person illuminates our understanding of those ancient occupants and the Ice Age environments that supported them'.

Darwinian evolution. When Native American representatives in northern Washington State insisted that 9,000 year old Kennewick Man, with his supposedly Caucasoid features, is their ultimate ancestor, and Federal legislation backed them up, alarm bells rang for scientists from many disciplines other than archaeology and anthropology. They publicly decried the evil 'philosophical relativists', troublesome 'Indian chauvinists' and 'Indian tribes' creationists', dangerous 'anti-scientific dogma' and woolly-headed, 'guilt-ridden' 'liberal intellectuals' who sought to limit intellectual freedom.

With rather more circumspection, John Mulvaney, writing about the 'return' of skeletons from Kow Swamp to the Echuca Aboriginal Cooperative in August 1990, described that outcome as 'a triumph of bureaucracy and irrationality over prudence and positive, collaborative racial relations', the replacement of 'white violence and repression with black intellectual totalitarianism. It is not simply the Kow Swamp relics which are at stake, but the future of past Aboriginal culture, and the freedom of all peoples of any race to study it'. He asserted that claims to absolute knowledge of the past, representing 'an amalgam of Dreaming beliefs and anti-evolutionary Christian fundamentalism', challenge the 'intellectual freedom of every Australian, especially future Kooris'.

When 'cultural property' and 'ancestors' are reconfigured as other people's 'geological heritage' and 'scientific data', the purpose of a national or trans-national treasure chest of places worth keeping is called into question. Is it to safeguard things and places for 'posterity', for 'all humankind', for 'science' and 'the future'? Is it a noble exercise fostered by philanthropic governments and the United Nations, which care about 'the past' and its material remains for their own sakes? Is it a cynical or an idealistic exercise in extending national unity into the pre-national past, in the interest of a cohesive nation state, by appropriating aspects of indigenous cultures and pasts arbitrarily regarded as having value? Or are the reasons multiplicit, entwined and unfathomable? In suggesting that a nationalistic agenda may underlie the celebration and appropriation of antiquity in Australia, I do not mean necessarily to impute cynicism to those involved in heritage or archaeological studies, just as the suggestion,

70 For example, see Johnson, 'Indian tribes' creationists thwart Archaeologists', Josie Appleton, 'Battle of the bones', Spiked Culture 12 December 2002, online www.spiked-online.com/Articles; Norman Levitt, 'Kennewick Man: burying the truth about America's past', Spiked Culture 9 January 2001, online www.spiked-online.com/Articles.


72 Mulvaney, 'Past regained', 19.
like Chippindale's or Benedict's, that Indigenous claims for reburial are entirely or largely politically-motivated oversimplifies the situation.

Most Australian archaeologists, and their governing body, the Australian Archaeological Association, support the transfer of post-1788 remains to communities, 'because social and spiritual considerations outweigh other factors'. Those who oppose reburial or destruction of 'prehistoric' human remains point out that Pleistocene remains are hundreds of generations removed from living people. Any line of descent is to Aboriginal Australians everywhere, rather than to those people living in a specific region, like Balranald or Echuca on the Murray River. Important information about demography, disease, migration and descent is lost when skeletal material is destroyed. Re-burial can be even worse, because if it is not properly documented, the integrity of entire sites becomes suspect. Mulvaney pointed out that 'controlled scholarly enquiry and racial collaboration, which synthesizes these finds and re-assessments with traditional Aboriginal knowledge, benefits all in a free society'. There is a fear among some museum curators that repatriation of any cultural property will 'open the flood gates to the destruction of collections'.

Those who oppose the study of Aboriginal skeletal remains irrespective of age point out that the age of an ancestor is irrelevant spiritually. They can also point to a history of grave-robbing, cultural looting, dispossession, and lack of consultation. Furthermore, textbooks and articles, particularly in the case of the Mungo remains, have displayed photographs of Mungo 1 and Mungo 3. Initially this involved ignorance of the distress and offence the images would cause many Aboriginal people, but newspapers and academic productions continue to include these photographs, particularly the charismatic images of the partially excavated Mungo 3 skeleton in 1974.

Repatriation is often equated with destruction. At a conference in Melbourne in

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73 Mulvaney, 'Past regained', 16.
74 Michael Pickering, 'Repatriation, rhetoric and reality: The repatriation of Australian Indigenous human remains and sacred objects', Paper presented at the Australian Registrars Committee Conference, 9 October 2001, Melbourne. Pickering was then the Repatriation Program Director at the National Museum of Australia.
75 Mulvaney, 'Past regained', 17.
76 Pickering, 'Repatriation, rhetoric and reality'.
77 Pickering, 'Repatriation, rhetoric and reality'.
78 Colley, Uncovering Australia, 164-5. For examples, see Anon., 'New dates for Mungo III announced', ANU Archaeology On-line Newsletter, May 1999; Bowler, Lake Mungo: Window to Australia's Past (although note Bowler's awareness of the discomfort that the images might cause Indigenous people, and the warning at the start of the cd); Grose, 'Mungo Man critics say skeleton may belong to younger Mungo
2001, Michael Pickering, the National Museum of Australia's Director of Repatriation, pointed out that successful repatriation is about empowerment, and need not even involve the physical transfer of property, simply an acknowledgement of custodianship or ownership, and an undertaking to consult.\textsuperscript{79} It can be seen as an act of good faith. The struggle surrounding the interpretation and disposition of the human past in Australian history and prehistory is partly about atonement, reconciliation and human dignity as much as it is about science, 'ideology and ownership'.

Aboriginal people have gained much in terms of mainstream public perception from the discoveries and publications of archaeologists over the last 35 years.\textsuperscript{80} The phrase '40,000 years' entered the vernacular during the early 1970s as a direct response to the publication of Mungo dates.\textsuperscript{81} The temporal expansion allowed by this archaeological work accompanied changing socio-political agenda of both scientists and Aboriginal people, as Jim Bowler pointed out in an address to the Royal Society of Victoria in October 1981, as the recipient of the society's Research Medal for the year, on the topic 'From Mungo to Noonkanbah: Scientific development or racist exploitation?'.\textsuperscript{82} He worried that refusal by traditional tribal groups to permit the study of Aboriginal prehistory could serve to propagate the implicit assertions of Eurocentric national history, that non-literate people have no history.

Bowler pointed to problems of a cult of personality in Australian academia, and to intellectual rivalries spanning at least three institutions – Melbourne, Sydney and the ANU – which have affected interpretation of the Willandra Lakes material, and further politicised an already volatile situation. This cult of personality applies to human remains and cultural property as well. Mungo Lady has given 'a hell of a lot' both to archaeologists and to Indigenous people, as Joyce Smith of the Mutthi Mutthi people said in 1999, calling for her reburial at the spot where Bowler found her: 'They just have to take this one more step in putting this very sacred person to rest. She has given so much to our people and she's given the scientific world a hell of a lot, too'.\textsuperscript{83}

\textsuperscript{79} Pickering, 'Repatriation, rhetoric and reality'.
\textsuperscript{80} Bowler, \textit{Lake Mungo: Window to Australia's Past}; Mulvaney, 'Past regained', 17.
\textsuperscript{81} Bowler, \textit{Lake Mungo: Window to Australia's Past}.
\textsuperscript{82} Victorian Quaternary Group Papers, Circular 30, 8 October 1981 (private collection of E B Joyce, School of Earth Sciences, University of Melbourne). Bowler worked closely with Aboriginal people while doing geomorphological work near Noonkanbah, in Western Australia's Kimberley region, in the late 1970s.
\textsuperscript{83} Quoted in Jopson, 'Lay ancient Mungos' bones to final rest, say custodians', 5. See also Colley, \textit{Uncovering Australia}, 165.
Bowler himself pointed out the inability of scientists in the Willandra Lakes World Heritage Region to manage the cultural and skeletal material constantly emerging from the dunes. Mungo Lady's spiritual importance now outweighs her scientific significance. Other skeletons emerge and will continue to emerge out of the lunettes and dunefields which can reveal even more than she has about Aboriginal origins and human adaptation to late Pleistocene environments. So why the reluctance to bury this one, pawed and pored-over, over-determined bundle of burned bones from a calcrete block? It is what she represents, as the first marker of great human antiquity in Australia that makes her as important symbolically as she is scientifically to archaeologists. Courtesy of her media prominence, she has been gathered into the bosom of the nation, to represent all our beginnings.

'The desired future' of the title is found in the watered past. We take both comfort and trepidation from our new awareness of larger climatic cycles beyond human-induced depredations. The desired future also rests in a landscape which can accommodate intellectual endeavour, limited pastoralism, cultural tourism and the requirements of its Aboriginal custodians. It is a metaphysical landscape as devoid of the 'clinical dissection' of other people's prehistory as it is of 'Indigenous Creationists'' grandstanding. It is a landscape where the overwrought past of body-snatching, craniometrics and the hunt for an essential primitive can be re-interred peaceably, while those archaeologists and physical anthropologists who feel they are fighting for the viability of their discipline can negotiate a future wherein the study of human remains is welcomed by Aboriginal people. Unfortunately, no knowledge is apolitical, and the past does not stay buried.

I have finished with an essay on the lakes in part to enable the thesis to culminate with a 'national' landscape regarded by many as iconic, a landscape or set of landscapes, 'typically Australian in character', that allow me to play with earlier themes about antiquity, heritage and scientific knowledge. But unlike Hallett Cove or Lake Callabonna, the World Heritage listed Willandra Lakes have entered a global canon of culturally significant scientific landscapes. More significantly, the Mungo stories bring human beings decisively into the Pleistocene picture.

With human presence comes human politics. The specific, intimate, personal stories of the Willandra Lakes' history and prehistory become incorporated into regional, community and academic debates, played out on national and international stages. Some archaeologists envisage a world free of Indigenous politics, and warn that there will come a day when people of Aboriginal or Native American ancestry, trained as archaeologists, wish to find out about their own destroyed prehistories. Those in

1 Bowler and Magee, 'Geomorphology of the Willandra Lakes World Heritage Area', 1.
favour of the repatriation and even the destruction of human remains have countered that the search for 'origins' in Australia is irrelevant and even counter-productive, as Aboriginal people know that they have always been here. Archaeologists who are prepared to give up all claim to 'historical' or 'known' burials are unwilling to relinquish their claim to the right to study 'prehistoric' remains. In turn, some Aboriginal people argue that all remains are ancestors, regardless of age, and there is no statute of limitations of the sacred. The past practices of naturalists, physical anthropologists and antiquarians cast long shadows over the controversy.

So far, sites like Hallett Cove and Lake Callabonna, with little or no obvious ancient material culture or human skeletal remains, stay relatively free of the angst and outrage that accompanies intellectual endeavour in the Willandra Lakes. However as Parts Two and Three demonstrate, they are far from blank slates on which western scientists have inscribed geological knowledge. Incidents like the Broome trackways theft, and accounts like the Kadimakara explanations of the Dieri demonstrate that all Australian landscapes are layered with practical and spiritual significance for Aboriginal people.

The three threads of this essay track major themes of aridity and the watered inland; a social history of land management, interpretation and value in western New South Wales; and the potentially irreconcilable stories of archaeology and the disposition of material culture. These threads are united in the competing sacralisations of heritage, science, pastoralism and Aboriginal custodianship, and the coincidence of human occupation. In some sense each of the themes involves a battle for the control of meaning in the landscape. But meaning is established neither by physical geography, painters, poets, farming methods, palaeontology, archaeology, novelists nor World Heritage guidelines alone. It is the cultural and intellectual overburden that distinguishes the Willandra Lakes World Heritage site, as it is viewed and imagined, from broad ovoid saltbush plains fringed by eroding dune deposits. The power of deep time to add contour and colour to 'dead' landscapes is akin to the transformative effect of Technicolor on Dorothy's experience of the shift from Kansas to Oz, as we move from the eroding Mungo lunette, via the fourth dimension, to a fully treed and watered landscape: the Pleistocene land of lakes.3

3 Bowler, 'Aridity in Australia', 279-310; Bowler and Jones, 'Australia was a land of lakes'.

PART FOUR – LAKE MUNGO, HUMAN ANTIQUITY AND THE WATERED INLAND
PLATE 37. Maps showing the Willandra Lakes and major tributaries of the Murray-Darling Basin.


Clockwise from top left, close-up of midden showing unio (freshwater mussel) shells; fish otoliths (ear bones) from midden; bone point; *velesunio* middens along the Mulurulu lunette.
PLATE 39. Reconstruction of Pleistocene human habitation of the Lake Mungo lunette, showing 'telescoping'.

From John Mulvaney and Johan Kamminga, 1999, *Prehistory of Australia* (Sydney: Allen & Unwin). Caption reads 'Life at Lake Mungo about 30,000 years BP. This reconstruction is based upon archaeological finds and inferences drawn from them, but telescopes data across thousands of years into one day (G Caselli)'.

PLATE 40. Excerpt from map of T L Mitchell's south eastern Australian expeditions, showing the 'Gol Gol Ranges'.


PLATE 42. Modern gullying in the Willandra Lakes World Heritage Region.
Lake Mulurulu lunette (Photo K Douglas).

A grey clay layer overlies fine sandy layers with interbedded clay laminations.
PLATE 44. Palaeo-gully and yardang-style erosion in a gully wall, Lake Mulurulu, Willandra Lakes (photo K Douglas).
PLATE 45. Pliocene beach ridges in the Murray-Darling Basin.
These relict shorelines may have controlled the alignment of the main Willandra Lakes lunettes.
Image courtesy Mike Sandiford. Created from SRTM (Shuttle Radar Topographic Mission) digital elevation data at 30 arcsecond spatial resolution.
PLATE 46. Gypcrete formation at core of Lake Mulurulu lunette (photo K Douglas).
Possible remnant of an onshore hypersaline lagoon.
PLATE 47. Lunette formation.

A. Formation of a typical quartz sand lunette.

B. Formation of a typical clay lunette.

PLATE 48. Lunette, Lake Mulerulu.

From top, facing away from lake; facing lake looking south-west; re-mobilised whaleback on western (non-lake-bed) side of lunette (photos K Douglas)
PLATE 49. Lake Garnpung lunette (photo M Main).
Landslides are the collection of physical and ecological features given meaning through a sense of beauty, and perspective of the past, and an understanding of the economic and cultural forces that shape the present ... the physical manifestation of people-land relationships that have evolved over many centuries.\(^1\)

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A landscape is more than a set of physical, biotic and climatic attributes superimposed over bedrock. To leave it at three dimensions is to deny the richness of time and the human past. George Seddon wrote in 1996 that ‘Human history is not complete without environmental history. It is not enough to detail the actions of the actors; the stage is equally important’. Indeed, without the stage, we would have no awareness of the scale of the human action. Without recognition of the depth of ecological history, we could comprehend no deep human history.

Based on evidence from the ground beneath their feet, and on first hand observation of the slow dissolution of the earth on human timescales, most European naturalists at the beginning of the nineteenth century accepted that the age of the earth was greater than the few thousand years prescribed by Biblical chronologies. By 1800, Georges Cuvier had proved the reality and apparent periodicity of the extinction of species in the fossil record, to his own satisfaction and eventually to the satisfaction of most of his peers, demonstrating that modern biota had a deep past. Further discoveries of extinct fossil remains during the century continued the challenge to biblical literalism offered by the natural world, and propelled the study of vertebrate palaeontology into the public consciousness.

In 1830 the publisher John Murray released the first volume of Charles Lyell's seminal Principles of Geology. Lyell's text set out to control the terms in which a discipline defined itself and in the process furnished a convincing model for the gradual shaping and reshaping of the earth over time, by causes now in operation.

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3 I do not intend to suggest that Cuvier believed that modern faunal assemblages were derived in any genealogical sense from ancient ones. He asserted quite the reverse, that modern Eurasian and American environments saw the arrival of a modern fauna that was unrelated to extinct genera and migrated from elsewhere following relatively localised extinction events in Eurasia and the Americas (for example, see Donald K Grayson, The Establishment of Human Antiquity [New York: Academic Press, 1983], 47-9).


mechanism susceptible to appropriation by proponents of both gradual and 'catastrophic' change, to account for the shape and ecologies of post-Pleistocene landscapes in Europe and the Americas.6

Before 1850, Charles Darwin had begun to flesh out the framework for a theory of the slow transmutation of species over time by natural selection, culminating in the first edition of *On the Origin of Species* in 1859.7 And the 1850s saw in the western scientific canon the beginnings of the establishment of a great depth of human antiquity, perhaps epitomised from an Anglocentric perspective in the publication in 1865 of John Lubbock's *Prehistoric Times*.8 The world of lived experience suddenly had a deep ancestry.

But with the relatively abrupt acceptance of a greater depth of time for human history, the counterfact of Seddon's observation emerged: Is it possible to study the history of the recent earth without taking human actions into account? The stage is important, but without actors it is of limited interest to the audience. The theatre is a restrictive analogy: I do not wish to set up a dichotomy here between the works of humanity and the works of nature, but merely to point out, with Seddon, that 'human' and 'environmental' histories are inseparable. Not to put too anthropocentric a spin on it, late Quaternary history is at least in part the story of the interactions of human communities with their environments. In philosophical terms, acceptance of human prehistory opened an intellectual space for archaeology and physical anthropology to extend their compass into the deeper past. People became natural history objects.

In Australia, the age, affinities and origins of mainland and Tasmanian Aboriginal people were preoccupations of nineteenth-century geologists, comparative anatomists and physical anthropologists. They gleaned evidence for Aboriginal longevity or otherwise from the landscape, gathering the material remains of the past, including human burial remains, to support or dismantle theories, leaving a legacy of bitterness for their late twentieth-century intellectual successors and many modern

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Aboriginal people to negotiate.

The World Heritage significance of the Willandra Lakes region hinges upon this tension: the global and national importance and fascination of all 'prehistoric' human remains, versus their geographically and temporally specific cultural significance to Aboriginal Australians. In the words of Jim Bowler, the association of 'Ice Age environmental history with the story of human presence' at the lakes provides 'many aspects of modern social, even political relevance', as lines of demarcation are drawn in the sand dunes between scientific disciplines, institutions, pastoralists and Aboriginal people.9

Hallett Cove provides a deeper Ice Age story. When Ralph Tate discovered the scarred pavements south of Adelaide in the mid-1870s, debate about the possibility and nature of glaciation in Australia, on which hinged contemporary understanding of the distribution of species, distracted from the issue of the antiquity of the Hallett Cove features. In the space of ten years, these features aged from ten thousand to 240 million years by today's reckoning. We have no records of Kaurna interpretations of the grooves on the rock pavement, or the mysterious bus-sized boulders on the beach, but can be in no doubt that the people who camped for millennia on the cliff-tops incorporated this evidence of former worlds into their cosmologies. Quaternary change at the cove is represented by the striking erosional features of the Amphitheatre and memorialised in the tradition of Tjilbruke.

Ultimately, the significance of the site for academic geologists alone was not enough to save it from urban expansion in the 1960s. Instead a combination of public and institutional interest and government lobbying at a particularly friendly moment in South Australia for heritage legislation led to its protection. We cannot underestimate the importance of the memories of visits to the cove by the generations of South Australian school children and first year geology students forced to endure excursions in all weather in the seventy years since its scientific discovery. The bureaucratic legacy of the debate ensures that the cove landscapes are doubly celebrated, for their geological significance and for their role as a test case for natural heritage protection in South Australia.

At Lake Callabonna, Aboriginal oral traditions about giant bones in the

landscape resonate with palaeontological orthodoxy about change over time and cyclical climate shifts. Its protection, since 1901, is largely pragmatic, and reflects the limits of agriculture in South Australia as much as it does political concern with the status of fossils. The site, with its necropolis of Diprotodon and other megafaunal fossils, could be enormously important, were it not for the practical issues of isolation and accessibility, post-extraction preservation and reconstruction, and the associated costs.

Landscapes reverberate with cultural, political and intellectual meaning, and the deeper chronology which informs the history of human interaction with the 'natural' and the built environment. Furthermore, modern landscapes are as much social and political phenomena as they are physically constructed. As heritage specialists O'Riordan, Shadrake and Wood asserted in the quote which prefaces this concluding essay, meaning in a landscape is established by 'a sense of beauty, and perspective on the past', as well as by other cultural and economic agents. Attitudes to place are formed by such perspectives. Modern landscapes are the 'physical manifestation of people-land relationships' evolving not over centuries, but over tens of millennia.

The importance of geological heritage lies in this conjunction of cultural and environmental histories with the earth sciences. As well as a research and educational resource, a site of geological or archaeological heritage is a memorialisation of human and landscape interactions, both physical and intellectual, significant for the construction of identity and for community appreciation of the genetic influences on country. It is hoped that understanding the land is the key to treating it better. Seddon stressed the importance of local geological knowledge to 'enhance the sense of place' to which we owe 'our sense of our individual and communal identities'. He noted that such a sense of belonging is basic to 'all sound environmental planning' and a key to 'feeling at home' in a landscape.

My aim has been to explore ideas about age in the landscape since the earliest public European acknowledgement of deep time in Australia, with the announcement of the Wellington Caves fossil discoveries in 1830. My major focus has been on the stories of discovery, interpretation, mobilisation and celebration of that deep past by geologists, palaeontologists, archaeologists, museum workers and their publics in the 170 years.
since then. Earth scientists and the promotion of geology play an integral role in the
creation and nurturing of Australian national or regional identities, through the use of
the material remains of former worlds to transform 'waste' or 'useless' country into a
four-dimensional, time-travelling entity with a deep future as well as a deep past.
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